

DEPARTMENT OF COMMERCE

CIRCULAR
OF THE
BUREAU OF STANDARDS

S. W. STRATTON, DIRECTOR

No. 56

STANDARDS FOR ELECTRIC SERVICE

[FIRST EDITION]
ISSUED JULY 28, 1916



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1916

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STANDARDS FOR ELECTRIC SERVICE

INTRODUCTION

The regulation by State commissions of public-service utilities other than common carriers is becoming more widespread yearly. Less than 10 years have elapsed since the first State commissions were created, yet regulation has already been established by law in greater or less degree in 30 or more States. It is now generally recognized that the supply of electric service is a natural monopoly, and should therefore be regulated by the State or by the municipality.

The intelligent and fair regulation of any utility requires a thorough knowledge of the elements that together constitute good service. It also requires a knowledge of what it is possible to supply at a given cost or what the increased cost will be if the service is improved in any particular respect. The Bureau has studied some of these questions with respect to gas service, and its publication, *Standards for Gas Service*,¹ is now in its third edition, there having been a very great demand for it from gas engineers and other representatives of the gas industry and also from public-service commissions and city officials. The time now seems ripe for the publication of a similar study and discussion of the subject of electric service.

The supply of electric energy from central stations for electric light and power had its first beginnings a little over 35 years ago. Marvelous advances have been made since then in the generation, distribution, and utilization of electrical energy, but the question of standards of service has been to a large extent ignored, due partly to the rapid growth and development of the industry and partly to the absence of any suitable agency for making a thorough study of the subject. The National Electric Light Association and the Association of Edison Illuminating Companies have done excellent work for years on the subject of meter specifications, but have not attempted to set standards of service.

A number of State commissions have adopted rules and recommendations for electric-service regulations which, however, vary

¹ Circular No. 32 of this Bureau.

considerably in their requirements. This makes it desirable to collect and compare the provisions of such State rules and to propose such standards as may be applicable generally.

A number of cities in States not having regulating commissions have established municipal commissions and inspection bureaus. The Bureau of Standards has cooperated with certain of these, as well as with State commissions, and has been to a certain extent a clearing house of information with reference to the important questions of standards and accepted good practice.

This Circular attempts, therefore, to present a survey of the general field of State and municipal regulations in so far as standards of electric service are concerned, and presents suggested rules and regulations which may be adopted as proposed or which may form the basis for rules and ordinances to be adopted by States and cities.

Criticisms and suggestions on this Circular are desired from all interested persons, especially from commissioners and engineers of commissions, public-utility operators and engineers, committees of technical societies, municipal commissions, municipalities, and operating companies. The Bureau is ready to assist to the fullest extent in the establishment of standards and the promotion of a good understanding between regulatory bodies, operators, and customers.

Acknowledgment is here made of the very cordial cooperation and assistance of commissions, committees of technical societies, and public-service corporations in the preparation of this Circular.

S. W. STRATTON,
Director.

Approved:

WILLIAM C. REDFIELD,
Secretary.

I. THE ADEQUACY AND SAFETY OF ELECTRIC SERVICE

A. ELECTRIC SERVICE STANDARDS

In many of the State laws establishing public-service commissions a very definite duty is imposed upon the commissions to require public utilities to "furnish safe, adequate, and proper service," or to furnish "such service and facilities as shall be safe and adequate and in all respects just and reasonable." In some cases the laws definitely state that utilities must not "provide or maintain any service that is unsafe, improper, or inadequate."

At the present time 33 States and the District of Columbia have laws to a greater or less degree regulating service furnished by electrical corporations. Legislation in other States is pending, and legislative committees are investigating the subject. Under the laws so far enacted the States of Arizona, Connecticut, Illinois, Indiana, Maryland,² Missouri, Montana, Nevada, New Hampshire, New Jersey, New York, Oregon, Pennsylvania, Washington, West Virginia, Wisconsin, and the District of Columbia through the public-service or railroad commissions have adopted rules and regulations for electric service. In Massachusetts the laws themselves specifically cover certain service standards, and no rules have been issued by authority of the regulating commission, as in other States. All State rules and regulations are summarized on pages 72 to 148 of this Circular.

The Board of Gas and Electric Light Commissioners of Massachusetts is the oldest body regulating public-service corporations not common carriers in the United States. The Railroad Commission of Wisconsin issued its first gas and electric service rules in 1908. As shown above, at this time (1916) in 16 States and in the District of Columbia electric utilities are required to conform to certain regulations as to standards of service. Public-service commissions in a number of other States are considering the adoption of service standards in accordance with the laws establishing and defining such commissions' powers.

The determination of what is safe, adequate, and proper electric service involves both engineering and economic questions, and a

² Maryland adopted rules in January, 1916, but too late to be inserted in this edition of this Circular. (See Appendix 3, p. 242.)

consideration of the relations which have developed in recent years between the public and the public utilities. Electric service, which is one of the important subjects of commission regulation to-day, had its origin 35 years ago,³ and the apparatus and methods for the generation, transformation, distribution, measurement, and utilization of electrical energy have since been developed with wonderful rapidity and success. Engineering and commercial electrical associations,⁴ both national and local, have been formed in considerable numbers, and have large memberships and great influence.

By the time that the first public-service commissions were established in 1907-1909, the business of supplying electric light and power had become an important and widespread industry, and electric service in its economic and social aspects had become "clothed with a public interest." Public-service commission laws have therefore been made to include the regulation of electric service, and the establishment of service standards is made mandatory in many of the States.⁵

In administering the provisions of the laws, in so far as they concern electric service, the public-service commissions found that they had under their jurisdiction a great number of electric central stations in which the conditions of operation and facilities for furnishing service varied widely. In drawing up rules and regulations, in order that central stations might have a uniform standard of service, it was found necessary to allow some flexibility in the rules so that those utilities that were at the time unable to meet all the requirements of the prescribed standards could be given reasonable time and opportunity to do so. Central stations are still operated in some communities under conditions which make it impracticable for the utility to meet all of the usual requirements of service standards. Under such circumstances suitable modifications and exceptions should be made.⁶

In a number of the States the public-service commission law does not give the commission jurisdiction over municipally owned plants.⁷

³ The first electric central station seems to have been the one established at Appleton, Wis., in 1881. This was a direct-current station. The first alternating-current station was started at Great Barrington, Mass., in 1886.

⁴ The American Institute of Electrical Engineers was founded 1884. The National Electric Light Association held its first convention in Chicago in 1885.

⁵ See Appendix 1, p. 202, for the laws now in force.

⁶ See 2 Wis. R. C. Reports, pp. 632, 642.

⁷ In Idaho, Indiana, Maine, Maryland, Massachusetts, Montana, New Jersey, Vermont, West Virginia, Wisconsin, and in California, by special vote of the people of a municipality, municipal utilities are under the jurisdiction of the commission.

It would seem, however, that if the customers of municipal plants, being both the owners of the plant and the ones who benefit by proper service regulations, were to understand the advantages of proper service standards, such standards would be adopted either as State rules or municipal ordinances. As the rules proposed in this circular ⁸ are just as suitable for municipally owned plants as for others it would be a decided advantage to have them adopted and observed and thereby secure uniformity of practice. If they are deemed not to be suitable in any particular, the Bureau would be glad to be informed so that any objections or difficulties may be removed in later editions.⁹

The general principles underlying the adequacy and safety of electric service and the reasons for the various rules and provisions of ordinances suggested are briefly discussed in what follows.

B. FACTORS INFLUENCING ADEQUACY OF ELECTRIC SERVICE

The adequacy, safety, and efficiency of electric service depend on many things and many conditions. Time and place, customs and convenience, and competition are general factors that must be considered in every case. Precisely the same service, in two different localities, may be adequate and reasonable in one, but inadequate and unsatisfactory in the other.

There are in all electric services three general sets of conditions that very largely determine the adequacy and efficiency of any such service. These conditions are: (a) Central-station operation; (b) the transmission and distribution system; (c) the energy measuring and translating devices.

The questions of voltage variations on lighting and power circuits, the interruptions of service, the frequency of alternation on alternating-current circuits, the accuracy of watthour and other meters, the efficiency of lamps, motors, and other energy-translating devices are factors affecting the adequacy of service, each one of which depends to a certain degree upon the three general conditions above named.

Thus, for example, the constancy of voltage on a lighting circuit depends upon the prime movers—the engines, turbines, or water-wheels—of the station; upon the regulation of the electric generators; upon the distribution lines and transformers; and upon the

⁸ See p. 149 for proposed commission rules.

⁹ On p. 185 and following are three ordinances, any one of which may serve as a starting point for service standards for municipally owned electric plants.

wiring on the customer's premises. Furthermore, questions of maximum load, time of use, the unbalancing of circuits, etc., have their part in determining the voltage supplied to apparatus on any line.

These various factors will be considered under the three general heads above named.

1. CENTRAL-STATION OPERATION

It is not the purpose here to discuss in any detail the problems of central-station operation, but simply to call attention to certain phases and factors that affect service and may properly become the subject of investigation and regulation by State or municipal commissions. Enormous differences exist in the sizes of central stations, ranging from 100 kilowatts or less¹⁰ capacity in smaller towns to tens of thousands of kilowatts capacity in the largest cities. Only certain questions can here be touched upon, and they apply more particularly to the smaller stations, of which there are very many more than there are of large stations.¹¹

(a) **Adequate Power and Generating Capacity.**—There are many central supply stations that have water-power plants with auxiliary sources of power, such as gasoline engines. In many cases these engines are of insufficient capacity to carry the load during periods of low water, accident to water-power plant, or other emergency. Poor service due to low or fluctuating voltage is often a result.

Central stations in the smaller towns at times find difficulty in supplying adequate service just at the time when most needed. Cases are not uncommon where householders must provide oil lamps and candles for emergency lighting; yet economic and commercial limitation may preclude better service.

In addition to the difficulty experienced by many plants in furnishing adequate service, due to lack of power, there is the further difficulty that in many cases service is inadequate, due to lack of generating capacity.

Accidents may occur at any time to boilers, engines, turbines, generators, transformers, or distribution lines. Adequate and

¹⁰ The smallest central station is probably the one at Waldo, Wis. Service at 30 volts direct current is supplied from a three-fourths-kilowatt generator and storage battery. *Engineering News*, 72, p. 1333 (Dec. 31, 1914).

¹¹ According to Bulletin 124, Bureau of Census, Central Electric Light and Power Stations 1912, there were 5221 central stations in 1912. A writer in the *Electrical Review* (vol. 63, p. 622) estimates that at least 4000 of these stations are in towns of 5000 inhabitants or less, while 3200 are in towns of less than 2500 people.

continuous service, so necessary in all industrial applications of electrical power, can hardly be given unless provision is made against emergencies. Stand-by units and duplicate lines are therefore important and should be provided when practicable.

(b) **Regulation of Generating Apparatus.**—The degree of uniformity of the voltage of supply circuits is perhaps the main criterion by which the public judges the adequacy and general excellence of electric service. This is because the candlepower of incandescent lamps varies widely with voltage variations, and can be observed without test instruments or technical knowledge.

A rather close voltage regulation is necessary in order to furnish satisfactory incandescent lighting service, although it is true that tungsten lamps are not so sensitive to voltage variations as were the old carbon lamps.¹² Good inherent voltage regulation is very necessary in the generators used in the smaller central stations, but becomes of less importance as the size of generating units is increased.

Prof. C. F. Scott, in discussing this general problem, says:¹³

Regulation of voltage on constant-potential supply circuits is one of the most important problems presented to the engineer who designs a plant, as well as to the one who operates it. Efficiency in apparatus in transmission, even affecting as it does the cost of power, is in many ways secondary in importance to regulation. Lower efficiency usually involves simply the burning of a little more coal, but poor regulation affects the quality of the service, and may greatly reduce its commercial value. It may result in either low candlepower or high lamp breakage; it may affect the speed, the capacity, the temperature, or the starting torque of motors; it may cause an otherwise satisfactory service to be a severe burden to the apparatus and to the patience of those who are dependent upon it.

It is necessary here to call attention only to the regulation of the generator voltage on the bus bars. There are automatic voltage regulators on the market and in wide use and they can be depended upon to keep the voltage fairly constant in value at any predetermined point on the circuit, usually at the bus bars. Such voltage regulators, however, are not generally used, largely on account of initial cost. Probably less than 30 per cent of the smaller stations use them. It can, however, be shown that the returns on the investment in automatic regulators for generators are sufficient to justify the initial expenditure even for small stations. In addition, the customer receives a greatly improved service which in turn benefits the utility.

¹² See p. 24 for tables showing effect of voltage variation.

¹³ *Electric Journal*, 5, p. 3 (1908).

(c) **Switchboard Instruments.**¹⁴—In early central station practice it was customary to use an incandescent lamp on the switchboard as an indicating voltmeter. The station operator regulated the voltage of the circuit by observing whether this lamp was too bright, or too dim or about right. For many years, however, the switchboard voltmeter has been one of the most important of central-station instruments, and the quality of the service rendered by a station is very well indicated by such voltmeters. Graphic or curve drawing voltmeters should also be installed even in the smallest stations. They are especially valuable when conditions of voltage regulation are complained of by customers, and are required by the rules of many State commissions.

Switchboard voltmeters are, of course, subject to errors and station instruments are rarely correct within 1 volt, while errors of 2 or 3 volts are not uncommon. Alternating-current instruments seem to be more apt to read high than low, though of course errors are liable to occur in either direction.

A voltmeter that reads too high is a source of loss of revenue to the utility (that is, the energy output is less than it is thought to be) and if considerably in error is likely to cause complaint from customers. A station voltmeter reading 1 per cent high, for example, causes a direct loss in revenue on lighting load of about 1.5 per cent while the candlepower of tungsten lamps operated on such a circuit, that is, one actually 1 per cent low in voltage, will be decreased by about 3.5 per cent.

Voltmeters used with voltage transformers may give readings too low if care is not exercised to prevent the overloading of the voltage transformer. Voltmeters reading low tend to increase complaints of customers on lamps due to early failure caused by too high voltage.

Switchboard ammeters need not be discussed in this connection further than to call attention to errors that may be introduced by faulty connections between shunt and main circuits, and between shunt and instruments on direct current circuits, and by overloads on instrument transformers on alternating-current circuits. Large errors may be thus introduced and circuits overloaded and possibly damaged.

Ammeters and voltmeters are the most important indicating instruments on switchboards, and are the only ones in many supply stations. In order, however, for utilities to comply with

¹⁴ See B. S. Circular No. 20, 2d ed.

the requirements imposed by certain municipal and State commissions, indicating wattmeters and frequency meters are necessary. The New York Public Service Commission, second district, requires watthour meters to be installed in stations in addition to indicating wattmeters.¹⁵

On alternating-current systems the product of volts and amperes as indicated by a voltmeter and ammeter is rarely the true measure of the power in a circuit. Systems operating at unity power factor are almost unknown. An instrument that will show the true power is therefore necessary and indicating wattmeters are thus desirable. A wattmeter in conjunction with a voltmeter and ammeter allows comparison of volt-amperes and true watts, thus serving the purpose of a power factor indicator.

Frequency meters are necessary to comply with the rules of certain States, and are of help to the station operator in giving an indication of the constancy and accuracy of speed. A frequency indicator, showing upon a scale the frequency on the circuit (which is proportional to the speed of the machine), is especially useful in water-power stations where in many cases the speed of the prime mover is rather variable.

(d) **Station Records.**—Electric service to be adequate as defined by State commissions must be reliable, and interruptions must be kept down to a minimum. Many State commissions (see p. 97) require utilities to keep careful and complete records of all interruption to service. In the rules of Pennsylvania an interruption is defined "for purposes of record only as the interval of time during which the voltage falls below 50 per cent of the standard voltage," while in the Wisconsin rules an interruption is a "period of over 30 seconds during which the voltage on the circuit is less than 80 per cent of its normal value."

Undoubtedly records of interruptions, showing the time, duration, and cause of each interruption make for better operation of the station and better service to the public.

Station logs or records showing time of starting and stopping machines, time of turning street lights on and off, and readings of station instruments are rightly required by many of the rules adopted by regulating commissions. Where only all-night service or service from dusk to midnight is furnished, such records are especially important. Full, complete, and careful station records are of great value to the operating utility in rate and valua-

¹⁵ See p. 142, this Circular, for New York, second district, order effective Sept. 1, 1912.

tion cases, and no station is too small to keep a record of its operating, even though but one man is employed for all work. The effect of such records is to cause the operator to run his plant carefully, not only because customers will be benefited, but because the records will look better if the plant is carefully run.

2. DISTRIBUTION SYSTEMS

The design and maintenance of the distribution lines and their auxiliary apparatus determine to a large extent the character of the service from the standpoints of continuity of service and good voltage regulation. Unavoidable losses always occur, but it is unfortunately not uncommon to find distribution systems so designed as to make the losses excessive and the distributing conductors themselves mechanically weak and more or less dangerous to life and property.

Many instances might be cited to show that inadequate and unsatisfactory service is due to unfamiliarity with what is good practice and a disregard for proper standards of good service.

(a) **Voltage Regulation of Feeders and Mains.**—The maintenance of constant voltage on distributing systems is of great importance, and the failure to maintain constant voltage is one chief cause for complaint from consumers.¹⁶ The voltage regulation of generators has been briefly referred to, but it is desirable to refer more specifically to the regulation of feeders, and primary and secondary mains.

The regulation of direct-current systems is most readily obtained by the interconnection of feeders and mains. These interconnections tend to relieve heavily loaded lines, by throwing the load partly on adjacent feeders in the same network. In other cases where larger differences in the loads or lengths of the lines exist, it often becomes necessary to operate several sets of bus bars, each at a different voltage, to which the distributing lines are connected, the longest lines to the busses of highest voltage. On the very largest systems motor-boosters are used very successfully to meet special conditions of a temporary nature.

On alternating-current circuits good regulation is most readily accomplished by voltage, or potential, regulators, either of the

¹⁶ "The petitioners presented a number of witnesses, patrons of the respondent company, who testified as to the character of service rendered, claiming that by reason of low voltage, leakage, insufficient power, and other plant and maintenance defects, the electric lights were dim, at times flickering or flashing, and that frequently there were no lights; that the company failed and neglected, because of inadequate plant and equipment, to supply current for moderate power purposes on request, and that the rates charged were unreasonable for the character of the service rendered." (Report, P. U. Com., Connecticut, 1913, p. lxx.)

"The question of regulation is very important. You know the man that comes in and kicks usually is not kicking so much on his bill as he is on his regulation." (Trans. A. I. E. E., 31, pt. 1, p. 439 (1912).)

induction or step type. Induction regulators are made either for hand or for automatic motor operation, and can ordinarily be relied upon to maintain a uniform voltage at all loads at the center of distribution to within about 1 per cent. As the peak load will usually occur at different times on different feeders, and as the necessary amount of compensation (i. e., increase or decrease of voltage) depends upon the load and the length of the feeder, it is evident that in many cases good regulation is only possible when each feeder is independently regulated.¹⁷

(b) **Transformer and Secondary-Main Losses.**—In addition to the voltage drop in feeders and primary mains there is a voltage drop in transformers and secondary mains. These voltage drops can not be compensated for by regulators, but must be taken care of by selection of transformers with good regulation, careful supervision of conditions of load on each transformer of the system, and the proper size of conductors for the secondary mains. Transformers sometimes become overloaded, due to rapid growth of individual customer's loads, the number of customers to be supplied from one distributing point, and insufficient station records of transformer installations and their connected loads. It should be noted, too, that the regulation of transformers is dependent on the power factor of the load, and some transformers while giving good regulation on noninductive load may cause large voltage drop at full load on mixed motor and lighting load.

As it is well recognized in practice and in commission rules on voltage regulation that variations in voltage on distinctly power circuits may be much wider than on lighting circuits, this difference should be kept in mind in designing or rearranging a secondary distribution system. Circuits used primarily for lighting should be designed for a maximum voltage variation at the company's main service terminals of not more than 5 per cent plus or minus from the nominal standard average voltage, while 10 per cent plus or minus may be allowed on power lines.

Commission rules now in force in some States allow only 3 per cent variation in voltage, but there is lack of sufficient evidence to

¹⁷ "One particular advantage of the automatic regulator is that feeders may be more heavily loaded and yet perfectly satisfactory service is rendered, thereby making a great saving in the cost of reinforcing or primarily constructing extra heavy feeders; for without automatic feeder regulation it is necessary in order to give satisfactory service to have a wire of such size as to carry its maximum load with a very slight drop. We have had many cases where the installation of automatic regulators has saved us the cost of reinforcing the lines, while the cost of the regulator was only a very small fraction of the reinforcement. At the same time the average losses of the line were not excessive and would not justify a reinforcement when considered on the basis of all day loss, but under peak conditions the losses were so excessive that the service was limited and the earning capacity of the feeder curtailed." (Jenks, J. S. *Electric Journal*, 11, p. 312 (1914).)

show definitely whether or not utilities generally can comply with the rules adopted. Systematic voltage surveys are not available except in a few instances, but these seem to indicate that on mixed lighting and power service variations of 5 per cent are not uncommon even in the case of the very largest utilities and operating under commission rules. A 5 per cent plus or minus variation is therefore specified in the rules proposed in this circular, with a limitation that the total fluctuations from minimum to maximum shall not exceed 6 per cent of the average in cities and other incorporated places having a population in excess of 2500 people, nor 8 per cent in all other places.

The size of wire to be used on the various parts of a distribution system depends on the voltage drop and power loss that can be allowed, taking into consideration the prospective increase in load. The size of transformers and secondary distribution mains needs special consideration, for it should be realized and understood that there are sizes of wire and capacities of transformers for any part of a system that are most economical under given local conditions of operation, labor, and material cost. Furthermore, the system designed for the most economical operation will also furnish service of excellent voltage regulation, for it usually follows that if a secondary system is so designed as to make the fixed and operating annual charges, including, of course, interest charges, maintenance, and power losses in transformers and wires, a minimum, for the usual conditions of operation wire sizes will be found to be such that voltage drops are well within the limits set in the rules proposed in this circular, and the lines themselves mechanically well designed to withstand storms and ice loadings. It should be pointed out that in many instances where large voltage drops occur and lines may not be within the limits set in the National Electrical Safety Code as to mechanical strength, it will be found that the fixed and operating charges are also greater than they should be.

There are, of course, many situations where first-class service is not economically possible. In suburban or rural districts or where service, if to be had at all, must be furnished directly from high voltage transmission lines, wider voltage variations are justified than can be specified in any general commission rule. A reasonable rule, definitely stated, with exceptions made for specific cases, will improve service and in the end benefit both utility and customer.

(c) **Efficiency of Distribution.**—For purposes of complying with commission rules and regulations a knowledge of the efficiency of distribution—that is, the ratio of the energy sold at customers' service terminals to the energy delivered to the bus bar by the generators—is of importance.

Losses are of various kinds, such as line loss, transformer loss, meter loss and error, leakage, and unaccounted-for losses. On lighting systems the losses at full load will usually be from 15 to 25 per cent of the power supplied to the bus bar on the average alternating-current circuit. It has been estimated that about 14 per cent of this loss is meter shunt loss, about 50 per cent transformer core loss, and the remaining 36 per cent is line and transformer copper loss, and leakage.¹⁸ A number of State commissions require careful records of station loads and output for purposes of proper accounting and report.¹⁹ (See p. 141.)

3. METERS.

(a) **Accuracy Requirements for Watthour Meters.**—Commission rules and city ordinances should definitely state to what degree of accuracy watthour meters should be adjusted when installed or after test. It is possible to adjust meters to within 1 per cent both at light load and at heavy load, although it may be difficult to obtain so high a degree of accuracy under certain service conditions. To prevent creeping of meters it is sometimes necessary to adjust meters so as to be as much as 4 per cent slow at light load. An adjustment to within 2 per cent plus or minus at both light and heavy load is, however, entirely practicable in nearly all cases, and of course closer adjustment should always be attempted.

Meters having errors in registration not in excess of 4 per cent to the prejudice of the customer are declared to be legally correct meters in many State laws and city ordinances. (See Appendix 2, Tables 1, 2, 3.)

The error of a watthour meter is in general different at light load from what it is at heavy load, and may have still other values at intermediate loads. The determination of the average error of a watthour meter and particularly its expression as a definite single value is not a simple matter, as it involves both technical and commercial considerations. It is necessary, however, to specify a defi-

¹⁸ *Electrical World*, 59, p. 947 (1912).

¹⁹ For the year 1912 the electric companies making reports to the New York Public Service Commission, 1st district, generated and purchased a total of 757 296 839 kwhrs. and reported as lost and unaccounted for 177 335 048 kwhrs., approximately 23.4 per cent. See annual report, 1912, vol. 3, p. 256.

nite method for its determination, so as to provide a predetermined basis for the settlement of questions which may arise as to fast and slow meters. Two methods are at present in use, a 2-point method, which considers the average of the errors at light load and at heavy load to be the average error of a meter, and the 3-point method, which in addition to finding the error at light and at heavy load finds the error at normal load and gives this a weight of 3 in computing the average error.

Practice and opinion among central-station operators differ with respect to this question, and this difference of opinion is reflected in existing commission rules.²⁰ Sufficient comparative facts are not at hand to determine the difference, if any, between results as computed by the two methods. Both methods are therefore suggested in the rules and ordinances in this circular. The selection of the method to be used in any State's rules or city's ordinances should be made after careful consideration of State-wide or local practice.

(b) **Installation and Testing of Meters.**—Proper and careful installation of meters in some uniform manner adapted to various types of meters and to different conditions of service is very desirable, in order that the maximum convenience to meter reader and tester be afforded with the minimum inconvenience to the customer. Installations must also be such as to insure safety and continuity of service.

In accepted good meter practice meters are placed in the cellar or first floor, or as near as possible to the service, in a clean, dry, safe place free from vibration and magnetic disturbances. In many instances, however, the service wires enter buildings through attics, and many companies find it necessary to install meters in attics for this reason. Apartment houses, office and loft buildings, represent a type of building where meters are best located on the floor where the service is rendered. Meters should not be installed in bathrooms, bedrooms, clothes closets, kitchens, coal bins, or in any location where the visits of the meter reader or tester may cause annoyance, or where the meter itself may suffer damage, unless such installation is unavoidable in order to furnish service.

Where two or more meters are installed on the same meter board, or in close proximity to one another, the distance between centers should not be less than 15 inches. Where several meters are thus grouped together, the various service circuits should be

²⁰ The 3-point method is specified in the rules of Connecticut, Maryland, Missouri, New Jersey, and New York, while the 2-point method is adopted in Illinois, Pennsylvania, and West Virginia.

plainly marked or tagged. Much annoyance and even danger to meter testers and customers may be avoided by such tagging of circuits. Although this is a matter primarily for the wiring contractor, and is usually required by the municipal wiring rules, there are many installations where the utility may find it advantageous to mark circuits for the convenience of its meter testers and customers.

In general the place of location of meters is a special problem to be worked out by each utility, keeping in mind the general principles here mentioned.

Installation tests are required by most commission regulations, and should be made whether required by rules or not, at least on all direct-current installations. The following table²¹ shows results obtained on 2500 commutator meters used on direct-current circuits. The results are obtained from several companies and are averages from installation tests. They indicate clearly the necessity for installation testing for commutator meters.

Test load	Percentage of total number not registering	Percentage of total over 4 per cent fast	Percentage of total over 4 per cent slow	Percentage of total correct between—	
				96 to 104 per cent	98 to 102 per cent
Heavy.....	0.2	2.0	6.0	92.0	70.0
Light.....	1.0	15.0	25.0	60.0	40.0

It has been estimated that the smaller companies have installed about 1.4 kilowatts of meter capacity for each kilowatt of generator capacity. It has also been shown in the case of one of the largest utilities, of the total plant investment for the alternating current system 25 per cent is for generating equipment and 17 per cent for meters. The generating investment for a residence customer is 26 per cent and the meter investment 18 per cent. From the investment standpoint it is seen that as careful maintenance of meters is demanded as for generators. Although the accuracy of meters is a question in which all customers are concerned, there are cases reported of central-station operators paying so little attention to meters that they confessedly did not know that there is anything about a meter that is adjustable.

No service can be considered adequate in which reasonable effort is not made to install reliable meters and maintain them accurate by periodic inspection and adjustment.

²¹Report of National Electric Light Association, Thirty-fourth Convention, 2, p. 235 (1911).

A system of carefully kept records seems essential, even in the case of the very small utility, for the proper supervision and maintenance of meter installations. Meter records should be kept for all meters owned by a utility, such record for each meter to begin when the meter is purchased and to be continued until the meter is scrapped or otherwise permanently removed from service. This record should cover at least the following items: (a) Manufacturer's number, utility's number, and all electrical characteristics of the meter, such as rated capacity, meter constant, two or three wire, alternating current or direct current, etc., (b) meter location with dates of purchase, installation, and removal, and (c) dates of tests made and tests due, with results of such tests. Practice differs as to the number of cards used for each meter for keeping records and as to the time other than property records are kept.

4. CUSTOMERS' UTILIZATION DEVICES

(a) **Incandescent Lamps.**—It has been estimated ²² that during 1915 approximately 111 000 000 incandescent filament lamps were sold, an increase over 1907 (the earliest figures available) of about 76.5 per cent. This is more than one lamp for each person in the United States. It has also been estimated that during 1912-1915 incandescent lamps of the four common types were sold in the following percentages:

	1912	1913	1914	1915
	Per cent	Per cent	Per cent	Per cent
Carbon.....	25.4	11.9	7.1	5.0
Gem.....	33.6	31.4	22.4	15.0
Tantalum.....	1.0	0.09		
Mazda.....	40.0	56.7	70.5	80.0

The incandescent lamp is the one type of electrical apparatus with which nearly everyone is to a certain extent familiar, and by which the adequacy of the electric service is most commonly and readily judged by customers of electric-supply companies.

With the exception of a relatively small number of lamps made for series burning for street lighting and street railway service, all incandescent lamps are designed for operation in multiple on constant-voltage circuits. During recent years there have been many changes made in the design and construction of tungsten filament lamps, all of which have tended to produce stronger lamps, adapting them to all conditions of service.

²² Report lamp committee, National Electric Light Association, Chicago meeting, 1916.

The candlepower of a lamp is to-day used as a distinguishing name only in connection with street-lighting lamps intended for series operation on constant-current circuits. Instead of candlepower the watts in connection with a voltage rating serve to distinguish lamps universally in the trade, and lamps are rated by manufacturers in watts and volts.²³ An incandescent lamp is now rated and labeled according to "its size," i. e., wattage consumption and the voltage of the circuit on which it is designed to operate.

If the voltage of the circuit is less than the rated voltage of the lamp operated on it, the watts consumed and the resultant candlepower are both less than at rated (i. e., labeled) voltage. On the other hand, a lamp operated on a circuit of higher voltage than that indicated on the label of the lamp, consumes more energy, gives a greater candlepower, and has a higher efficiency but a shorter life than when operated at rated voltage.

The efficiency of incandescent lamps, expressed in terms of watts per candle, is the ratio of the watts input to candlepower output; that is, it is the number of watts required by the lamp in producing 1 candlepower, and varies in incandescent lamps from 4 wpc (watts per candle) for carbon lamps of now nearly obsolete type to about 1.0 watt per candle and even less for the larger sizes of tungsten lamps. In the recently developed gas-filled or non-vacuum tungsten filament lamps the efficiency is still better, ranging from 0.75 to 0.5 watts per candle according to the size of the lamp.

J. W. Howell²⁴ in 1888 defined the maximum efficiency as the "efficiency at which the best results are produced by the lamp; or more accurately *the efficiency at which the cost of operating the lamp is a minimum.*" This definition is still true.

VOLTAGE AND FREQUENCY EFFECTS.—Candlepower, wattage, efficiency, and life of a lamp all depend upon the applied operating voltage, the life changing much more rapidly with voltage than do candlepower and efficiency. Adequate lighting service is ultimately dependent then upon two things, a very nearly constant uninterrupted voltage supply and a lamp adapted to such voltage supply. The cost of this lighting service is, in turn, dependent upon such factors as the cost of electrical energy, initial and renewal costs of the lamp, and average efficiency of the lamp.

²³ The "three-voltage rating plan" formerly used has also been given up, and lamps are now rated in watts and a single voltage.

²⁴ A. I. E. E., 5, p. 239 (1888).

Other additional factors need not be considered here. A life of 1000 hours for tungsten lamps has been generally agreed upon by manufacturers and the central-supply stations, and nearly all tungsten lamps are rated and labeled as to volts and watts so as to give this life on the average when operated at labeled voltage.²⁵ The specific consumption of lamps in watts per candle has, therefore, been periodically decreased by manufacturers, as lamps have been improved, so as to keep the average life at about 1000 hours, although the tests of the Bureau of Standards show a considerably higher life on the average. As a result, in tungsten filament lamps there has been a continued bettering of lamp efficiencies; that is, an increase in candlepower for the same wattage consumption without change in lamp life.

A similar progress has not been possible in the case of carbon, metallized-carbon, and tantalum filament lamps, and little change has been made in efficiency or length of life in such lamps. These lamps are rapidly becoming obsolete; in fact, the tantalum lamp has disappeared from the market.

Attention has already been directed to the variations produced in the operation of incandescent lamps caused by variations in the applied voltage. The following tables show clearly the large differences in candlepower, power consumption, and life made by voltage changes, in steps of 1 per cent.

TABLE A
Effect of Voltage Variation on Metallized Filament (Gem) Lamps²⁶

Volts	Candlepower	Total watts	Watts per candle	Current	Life
Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
95	79.3	91.7	115.6	96.5	245
96	83.2	93.2	112.2	97.2	205
97	87.3	94.9	108.8	97.9	169
98	91.4	96.6	105.7	98.6	141
99	95.6	98.3	102.8	99.3	118
100	100.0	100.0	100.0	100.0	100
101	104.5	101.7	97.3	100.7	85
102	109.2	103.4	94.8	101.4	72
103	114.0	105.1	92.4	102.1	61
104	119.0	106.8	90.0	102.8	52
105	124.2	108.6	87.6	103.5	44

²⁵ See B. S. Circular No. 13, 7th ed., Standard specifications for the purchase of incandescent lamps, 1915.

²⁶ With exception of last column, taken from lamp manufacturers' data book, sec. 70, sheet 1, Jan. 1, 1914.

TABLE B
Effect of Voltage Variations on Tungsten Filament (or Mazda) Lamps ²⁷

Volts	Candlepower	Total watts	Watts per candle	Current	Life
Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
95	83.1	92.2	111.0	97.0	216
96	85.3	93.7	108.7	97.6	185
97	89.6	95.3	106.3	98.2	158
98	93.0	96.9	104.2	98.9	136
99	96.4	98.4	102.0	99.4	117
100	100.0	100.0	100.0	100.0	100
101	103.6	101.6	98.0	100.6	86
102	107.4	103.2	96.1	101.2	74
103	111.2	104.8	94.2	101.8	64
104	115.1	106.4	92.5	102.3	56
105	119.0	108.0	90.8	102.8	49
110	140.3	116.3	82.9	105.7	25

²⁷ See B. S. Scientific Paper No. 238, "Characteristic equations of tungsten filament lamps," Middlekauff and Skogland, 1914.

These tables show that large variations in incandescent lamps are caused by voltage fluctuations, and indicate the necessity of close voltage regulation for adequate and economical lighting service. Voltage fluctuations exceeding from 3 to 5 per cent are evidently too great to give satisfactory service. Operation of lamps at lower voltage than that for which they are designed not only tends to decrease the utility's revenue and produce less candlepower, but it actually increases the cost of light per candlepower hour to the customer. On the other hand, operation at higher voltage increases the candlepower of the lamp, decreases the life, and increases the cost of lamp renewals. Close regulation is advantageous alike to central station and customer.²⁸

²⁸ Report lamp committee, National Electric Light Association, Philadelphia meeting 1914, commercial volume, p. 122:

"There can be no economy and there is an actual loss to the consumer and to the central-station company in operating lamps under the voltage for which they are intended, and a reasonable amount of attention to securing lamps of proper voltage for the circuits on which they are to be operated will conserve the interests of member companies, and improve the service rendered to customers.

"The table herewith presented will be interesting in this connection, showing, as it does, the variations in total watts and candlepower in percentage of the rated values due to variations in voltage above and below the rated, also the variations in total cost of light, including energy and cost of lamp renewals. For instance, a 112-volt, 100-watt lamp, if operated at 109 volts (98 per cent), would have a capacity of 96.9 per cent in watts and 93.2 per cent in candlepower and would cost for a given illumination 102.3 per cent, as compared with 100 per cent for all these values at 112 volts."

TABLE C.—Cost based on list price of 60-watt Mazda lamps and current at 10 cents per kwhr.

Per cent of rated lamp voltage	Wattage	Candlepower	Per cent of total cost of light at rated lamp voltage.
96	93.7	86.7	105.1
97	95.3	89.9	103.7
98	96.9	93.2	102.3
99	98.4	96.5	100.9
100	100.0	100.0	100.0
101	101.6	103.5	99.1
102	103.2	107.2	98.1
103	104.8	110.8	97.3
104	106.4	114.6	96.7

Frequencies of 60 cycles per second are satisfactory for all types of incandescent lamps. On 25-cycle circuits tungsten lamps of smaller sizes, such as 10, 15, 20, and 25 watts, operating at 110 volts and over, flicker perceptibly. In these lamps the wire filaments are of very small diameter, and consequently have small heat capacity, allowing the filament to cool sufficiently, as the current drops to zero (50 times per second on 25-cycle circuits) to cause a perceptible flicker. This flicker is less noticeable on carbon and metallized-filament lamps than on tungsten lamps of equal candlepower, due partly to the larger diameter filament in the former lamps. Tungsten filament lamps of smaller than 40 watts capacity are not entirely satisfactorily operated on 25-cycle circuits, on account of this flicker, unless inclosed in some type of shade or reflector that hides the filament of the lamp from direct view. Lamps of higher than 40 watts capacity operated at 110 volts do not flicker seriously on 25-cycle circuits.

SUPERVISION OF LIGHTING SERVICE.—As a large percentage of the gross income of central stations is derived from the lighting load, continuity of service, good voltage regulation, and reliable meters carefully maintained are very important factors in determining good lighting service and thereby making satisfied customers. In addition to these, however, a few State commissions require utilities to make periodic inspections of the lighting installations of their customers, especially when free lamp renewals are furnished by the utility.

While poorly designed lighting fixtures improperly located and supplied with more or less blackened lamps are unfortunately still not uncommon, there is a decided tendency on the part of customers to install new fixtures, providing more improved methods of lighting. An improvement in the appearance of the fixtures naturally results in the customer's desire to keep cleaner and more efficient lamps in service.

The questions of commercial policy involved in the determination of what may be the most satisfactory method to the public and to the utility companies in the matter of handling lamps required by the customer's installation presents a problem of considerable complexity. The great progress made in the manufacture of incandescent lamps, resulting in a rapid increase of lamp efficiencies and decrease in the prices of lamps, and the requirements of the public-service commission laws in a number of

States, conferring in some cases specific authority on the commission "to fix the initial efficiency of electric lamps furnished by electric companies,"²⁹ or "to prescribe from time to time the efficiency of the electric-supply system, of the current supplied, and of the lamps furnished by the persons or corporations generating and selling electric current,"³⁰ both tend to complicate the situation and make it extremely difficult at this time to say what service standards should be recommended.

Where the policy of free renewals obtain, carbon and gem lamps, although having an efficiency of only one-third to one-half that of tungsten filament lamps, are still being supplied as free-renewal lamps to a certain extent. The constantly lessening percentage of the lower efficiency lamps to the total sales show that the tungsten lamps are being more and more adopted by central station companies for renewal service.

Those companies which are pursuing the most progressive policy in these matters are furnishing tungsten lamps as renewals to a very large extent, and as the high-efficiency tungsten lamp is usually the most economical lamp for the customer to use, every effort should be made by central station companies to bring to the attention of their customers the advantage of using lamps of as high an efficiency as may be practicable under given service conditions.

Where lamps are supplied within the price charged for electrical energy on the "free-renewal" basis, they are, of course, paid for by the customer, as the rates cover the renewal cost to the utility company. With the present lamp efficiencies and at present prices, tungsten lamps, at any rate in the larger sizes, can be furnished to customers at the same or less renewal cost to the central stations than carbon or gem lamps.

A well-known central station manager has recently said:

The central station is interested in securing to its customers the highest standard of lighting service at the lowest practicable rates, and its commercial success and prosperity depend primarily on the excellence of its service. In maintaining a high standard of service the lamp itself is a factor of first importance. The central station does not aim to make the supply of incandescent lamps to its customers a source of profit; it seeks merely to cover its expenses in connection with the supply and handling of the lamps, and the better the quality of the lamps and the more cheaply it can supply them the greater the extent to which its ultimate aims are realized.

²⁹ Connecticut.

³⁰ District of Columbia, Maryland, Missouri, and New York.

If this is a fair statement of the policy of central stations in the matter of lamp renewals, they should make every effort to induce their customers to use lamps of higher efficiency.

The following statement presents concretely the argument for "free lamp renewals," and in order to provide an efficient lamp renewal service it involves a certain supervision by the central station over the customer's lighting installation:

If the central station makes lamps available to customers freely, a high lighting standard is maintained and the lighting service is satisfactory and attractive. Sockets are kept filled, lamps of uniform brilliancy are maintained, old and dim lamps are removed from the circuits, and the extensive use of light is encouraged.³¹

(b) **Motors.**—Induction motors are at times operated on circuits of different voltage or frequency from that for which the motors are rated. Under such conditions the performance of the motors will vary from standard conditions of efficiency. Voltage variations of 10 per cent on power circuits are allowed in most commission rules. The following is a brief statement of some operating results caused by 10 per cent voltage variations, and is indicative of the general type of changes produced in operating conditions by such voltage variations.

Operation at 10 per cent overvoltage causes a small increase in speed (about 1 per cent), increases the starting torque, gives slightly higher efficiency, but lower power factor. In general, operation at 10 per cent overvoltage at normal load is entirely satisfactory. At less than normal load the efficiency is, however, decreased.³²

Overvoltage of more than 10 per cent will make wider variations in operation characteristics, and will result in greatly reduced power factor and prevent cool operation.

Operation at undervoltage of about 10 per cent decreases the starting torque nearly 20 per cent, but improves the power factor

³¹ The following quotations from an opinion of the attorney of the Public Utilities Commission of Ohio (see annual report of the Public Utilities Commission of Ohio, 1914, p. 555) are of interest in this connection:

"Your commission requested of me an opinion as to the right of an electric-light company to refuse service to one of its customers because he substituted in his building Mazda lamps for carbon lamps, when the ordinance of the electric-light company provided that the electric-light company should charge a certain price for carbon lamps. * * *

"Mr. C. writes the commission as to the right of the power company to refuse him service because of the use of Mazda lamps. * * *

"The ordinance in question only fixes a price or rate for carbon lamps. Therefore, the electric-light company and the users of Mazda lamps in that village have a right, and should agree upon a price for Mazda lamps. If they can not agree upon a price, then the latter, by appeal to the court, can compel light companies to furnish lights to them at a reasonable price * * *."

³² G. C. Werner, *Electric Journal*, 3, p. 400 (1906).

somewhat. Greater reductions in voltage greatly reduce the efficiency, excessive temperature rise occurs, caused by large copper losses, and operation is in general unsatisfactory.

Higher than rated frequency improves the power factor, but decreases starting torque, and increases the speed, friction, and windage. At lower than rated frequency, the speed is of course decreased, starting torque is increased, and power factor slightly decreased. For certain kinds of motor load, such as in textile mills, close frequency regulation is essential.

(c) **Heating and Other Devices.**—During recent years a very great increase in the use of heating devices has taken place. Though it is well known to many users of incandescent lamps that proper voltage conditions are necessary for satisfactory lighting service (dim lamps or excessively bright lamps are easily seen), it is not so well known that satisfactory operation of heating devices is equally dependent on voltage regulation.

The voltage rating of heating appliances has been fixed to close limits, and most manufacturers have set definite limits on the voltage beyond which satisfactory operation can not be expected. This range is usually about 3.5 volts from a fixed standard. Flat-irons, warming pads and pans, curling irons, etc., do not need quite so close limits as do cooking devices. A low voltage applied to a cooking device is very unsatisfactory, because of the excessive time required to bring the device to the proper temperature, and successful operation is made difficult. Economical operation of cooking appliances depends to a very large degree upon the time required for the appliance to reach a certain temperature, and this in turn depends upon the voltage.

C. SAFETY OF ELECTRIC SERVICE

1. GENERAL STATEMENT

The public service commission laws in many States provide that electric service shall not only be *adequate* but also *safe*, and in a few States certain regulations governing safety requirements have been issued by the commission. In the State of New Jersey certain safety provisions are incorporated in the service rules issued by the commission, while in the States of Arizona, California, Idaho, Illinois, Nevada, and Oregon special regulations gov-

erning overhead and underground construction have been issued.³³ In the State of Connecticut the commission has issued certain recommendations with regard to safety, and in Washington a statute prescribes standards of construction and maintenance in considerable detail. In several other States the matter is under consideration by the industrial or public-service commissions.

The general questions of safety in the operation of electric utilities are discussed in detail in Circular 54 of the Bureau of Standards, and are therefore not considered in detail in this circular. There are, however, certain questions of safety regulation, such as the grounding of low-potential circuits, the general maintenance of plants, equipment, and distribution lines, and the inspection of transformers and other apparatus, which may constitute a fire or life hazard to the consumer if not carefully supervised and inspected, which will be briefly mentioned here.

³³ The following orders have been issued:

Arizona.—General Order No. 37. In the matter of overhead line construction. The order provides that all telephone, telegraph signal, trolley, and electric-light and power lines shall conform to specifications in the report of committee on overhead line construction of the N. E. L. A., thirty-fourth convention, New York, 1911. Order effective from and after July 1, 1914.

California.—General Order No. 26. Regulations governing clearances and construction at crossings of railroads, street railroads, telegraph, telephone, signal, trolley, and power lines, with each other and with streets and public highways; also other overhead and side clearances of railroads, street railroads, and wire lines. Approved Dec. 14, 1912. Effective Jan. 1, 1913. See also General Order No. 39, Aug. 20, 1914, and decision 1927, case 466, Nov. 7, 1914.

Connecticut.—Docket No. 1143. Approval of rules and regulations for safety of employees. Mar. 2, 1914.

Idaho.—Regulations and specifications governing the construction of overhead electric lines in the State of Idaho. Effective Mar. 1, 1915.

Illinois.—Rules governing the construction of telephone, telegraph, and other forms of electric transmission lines across similar lines, etc. Effective Apr. 2, 1914.

Nevada.—Safety regulations for electric utilities, Sept. 15, 1911.

New York, first district.—1. Order No. 1628. Safeguarding and protection of employees from injury by high-tension electrical apparatus, or other dangerous conditions. Jan. 13, 1914.

2. Order No. 1773. Notice to be given by each gas corporation, electric corporation, and steam corporation of every accident. * * * Dec. 29, 1913.

Oregon.—General regulations governing overhead and underground construction of telegraph, telephone; signal, trolley, and power lines within Oregon, as amended and effective May 12, 1914.

Washington.—Order of Aug. 14, 1914, amends and alters the act relating to electric construction. (Chap. 130, Laws, 1913.)

A list of specifications issued by various engineering societies, prepared for the purpose of promoting better and more uniform practice in construction is given below.

It is to be noted that these specifications are not, however, in all respects consistent with one another:

(a) N. E. L. A. Overhead-line construction committee, 1914 report, and section 3 of the 1911 report on joint use of poles by lighting and telephone companies.

(b) N. E. L. A. Specifications for overhead crossings of electric-light and power-transmission lines, 1913.

(c) Report of the joint committee on joint use of poles, A. E. R. A., 1914.

(d) Report of the committee on power distribution, A. E. R. A., 1914.

(e) The standardization rules of the A. I. E. E., 1915.

(f) Specifications for the replacement and reinforcement inspection of poles lines, A. T. & T. Co., 1912.

(g) Specifications for crossings of wires or cables of telegraph, telephone, signal, and other circuits of similar character over steam railroad rights of way, tracks, or lines of wires of the same class, Association of Railway Telegraph Superintendents, 1913.

NOTE. *National Electrical Safety Code*.—This code (Circular 54 of the Bureau of Standards) is a code of practice for the safe construction and operation of electrical supply equipment in stations, of electrical lines, both overhead and underground, and utilization of equipment in homes and factories.

To facilitate commission inspection and report on line construction, as well as for the convenience of the utility itself, posts, poles, or other structures similarly used should be distinctly numbered according to a definite scheme.

In electrical systems employing high potentials there is more or less danger to life from shock and the protection both of the employee and the customer against the dangers incident to the use of such potentials is an essential element of safe, proper, and adequate service, and every reasonable effort should be made to secure this protection.

In the service rules suggested for State regulation a few rules covering safety requirements are included, for the reason that certain requirements with reference to safety are a necessary part of service rules. These rules apply particularly to the grounding of low-potential circuits entering customers' premises and the inspection of apparatus of various kinds.

2. GROUNDING LOW-POTENTIAL CIRCUITS³⁴

The use of high voltage permits the most economical transmission of electrical energy over the considerable distances now covered by primary distribution, while low voltage is generally required for the safe and convenient operation of utilizing devices such as motors, lamps, etc. In alternating-current distribution it is customary to change this high voltage of the primary to the low potential of the secondary by means of transformers. In direct-current circuits (and to a large extent in alternating-current secondary circuits also) what is known as the 3-wire system is employed. Proper grounding³⁵ of low-potential circuits, such as direct-current 3-wire and alternating-current two or three wire, is recognized as an important factor in reducing both the life hazard and fire hazard in premises supplied from low voltage circuits because of the possibility of accidental contact between these circuits and higher voltage circuits. The danger to persons or inflammable materials is in shunting a portion of an electric

³⁴ The following rules, statutes, or recommendations are in force in the States named:

In Connecticut, Illinois, New Jersey, and West Virginia, rules for grounding are made a part of the general rules on standards of service. (See p. 94.)

Idaho.—General order No. 10, Jan. 21, 1915. Public Utilities Commission.

Maryland.—Order No. 1378, Sept. 4, 1913. Applicable only to Consolidated Gas, Electric Light & Power Co., of Baltimore. Public Service Commission.

Nevada.—Safety regulations for electric utilities, Dec. 2, 1911. Public Service Commission.

Oregon.—General regulations governing overhead and underground construction, May 22, 1914. Railroad Commission.

Washington.—An act relating to electrical construction, etc. (Laws 1913.)

³⁵ See National Electrical Safety Code, Bureau of Standards, Circular 54.

circuit having a high-potential drop, or in being subjected to the heat developed where a high drop of potential along a conducting path, or at an arc, develops large amounts of heat. The former is the danger to persons, the latter to combustible materials, and sometimes to persons in the vicinity.

Since persons are very frequently in contact with plumbing fixtures, reinforced concrete, gas and electric fixtures, damp floors and other surfaces in electrical connection with the earth, their greatest danger of shunting an electrical circuit comes from touching a single conductor of a circuit, elsewhere in contact with earth, and having at the point of contact a different potential than the earth. So many persons have been injured or killed by coming in contact with low-voltage conductors raised accidentally to high potential above earth by contact with or leakage from high-voltage circuits that the undue rise of potential above earth in conductors to which the public has access should always be prevented by the use of effective protective ground connections on the low-voltage conductors.

It is essential that the ground connection be of low resistance and continuously maintained; therefore it is advisable not to depend upon grounding at one point even if the ground connection is frequently inspected and shows a constant low resistance, but to ground the same conductor at several points. For direct-current 3-wire systems it is, however, necessary to restrict the number of ground connections and to depend on the adequacy of the ground connection at the station.

SAFE VOLTAGE.—The information available at present is not sufficiently complete to determine the safe limit to the voltage that may be allowed between an exposed ungrounded conductor and the ground. It is generally agreed, however, that voltages above 150 in commercial use are much more dangerous than those below 150. There is a strong trend toward inclosing or otherwise guarding against personal contact all ungrounded conductors over 150 volts to ground. Since it is impracticable to guard equipment on 110–130 volt 2-wire and 110–220 volt 3-wire circuits, it is essential that all such circuits be grounded. Even for higher voltage circuits, grounding is generally advisable. (See B. S. Circular No. 54.)

METHODS OF GROUNDING.—There are several methods of widely varying value employed to secure electrical connection of low-voltage circuits with the earth. Driving a piece of metallic pipe several feet into the earth, or burying metallic plates, are common

methods. Somewhat less common but more effective are continuous special ground conductors and attachment to metallic water-piping system.

If a buried ground plate or a metal pipe or rod driven into the earth is used, it is necessary that permanent moisture level be reached, otherwise a permanent low-resistance ground contact can not be obtained. Moist conducting earth is not always within reach, and pipe or plate grounds should never be used under such conditions.

The most satisfactory method of securing a reliable and permanent ground is connection to underground metallic water pipes, wherever this is possible. The resistance of pipe joints is usually low, the pipes present a large surface in intimate contact with earth that is always somewhat moist, in part due to slight leakage of water, and most important perhaps of all is the fact that piping systems are electrically continuous with the plumbing and heating fixtures with which people come in contact.

Unfortunately, it is still the case that some water companies and water departments of municipalities are reluctant to give permission to ground low-voltage circuits on their water pipes. No difficulty due to electrolysis will be experienced, however, as ordinarily no appreciable current will flow to or from the pipes. Moreover, the majority of systems to be grounded transmit and distribute energy by alternating current and the electrolytic effect of alternating currents is inappreciable. Under abnormal conditions considerable current might flow temporarily, but this would not injure the pipes and would produce a disturbance in the electrical system which would be at once detected and corrected. Electrolysis due to direct-current street-railway systems is often serious, but none can arise from the proper grounding of lighting circuits.

SIZE OF GROUND WIRE.—The proper size of wire to use in making ground connections depends upon the amount of current that might flow through such ground connection under abnormal conditions. In general, it may be considered adequate to make the current-carrying capacity of the ground wire equal to that of the conductor to which such wire is attached. The National Electrical Safety Code specifies that the ground wire shall not be smaller than No. 6 in any case, this being partly to assure sufficient mechanical strength.

RESISTANCE TO GROUND.—It is important that the resistance between the grounded conductor and the earth be permanently

kept low in order to reduce to a minimum the voltage drop due to current passing from the conductor to ground, especially where under abnormal conditions considerable current might flow. The effect of a high resistance ground may be illustrated by the following example: A ground connection of 10 ohms resistance, carrying 100 amperes, less than the capacity of many primary distribution circuits which might cross a secondary, and not sufficient to blow the fuses and relieve the dangerous condition, would cause 1000 volts drop between the grounded wire and the earth. Clearly, therefore, under these conditions such ground connection would not eliminate the life hazard. In the case cited the energy expended by the current passing through the ground connection would be 100 000 watts and the resulting heat might become a source of fire hazard. The heat thus generated would rapidly dry out the earth in close proximity to the ground contact and increase the resistance of the ground connection.³⁶

3. COMMISSION JURISDICTION AND PROCEDURE WITH REFERENCE TO ACCIDENTS

The laws under which most of the public service commissions are constituted give the commissions authority to require reports of accidents occurring in the operation and conduct of public utility enterprises, and in many instances this authority extends much further, so that commissions may issue orders prescribing safety rules and regulations.

It has seemed desirable to present a summary of the powers of the various State commissions with reference to accidents and safety provisions. The sections of the laws of the States bearing directly on the safety of operation and on the reporting and investigation of accidents have been compiled and will be found on page 202 of this Circular.

In addition to the sections of the laws referred to, the present status of the various commissions' safety and accident activities is concisely shown by the following brief statements from the commissions themselves.

ARIZONA

The only order issued by this commission covering regulations for safety and accidents is in A. C. C. Order No. 173, General Order No. 37.

Accidents occurring in the operation of gas and electric utilities are not reported to this commission or to any other State official.

We are of the opinion that our order in A. C. C. Docket No. 173 will provide ample protection to employees of electric corporations, so far as overhead construction is concerned.

³⁶ A full discussion of grounding is found in Bureau of Standards Circular No. 54, National Electrical Safety Code.

General Order No. 37 above referred to is entitled "In the matter of overhead line construction" and is effective from and after July 1, 1914. The order provides that all telephone, telegraph, signal, trolley, and electric light and power lines shall conform to specifications in the report of committee on overhead line construction of the National Electric Light Association, Thirty-fourth Convention, New York, 1911.

DISTRICT OF COLUMBIA

Order No. 6, "In re reports of accidents," dated April 1, 1913, has been issued.

Beyond the adoption of this order the commission has issued no rules or regulations specifically providing safety appliances or tending toward accident prevention. The accidents reported to the commission, however, are carefully analyzed and those which require it are investigated for the purpose of ascertaining whether existing conditions are such as to merit the exercise by the commission of its powers of requiring any changes in the practices or appliances of the utilities.

IDAHO

This commission has issued no rules, regulations, or orders on safety and accidents in accordance with section 42 of the public utilities act, except a circular letter requiring all utilities under our jurisdiction to render reports covering accidents of all kinds resulting in loss of life or damage to property occurring upon or in connection with their system or plants. Accidents occurring in the operation of gas and electric utilities are not reported to or investigated by any other State authority than this commission. (See General Order No. 3, Idaho Public Utilities Commission.)

ILLINOIS

With reference to the reports which this commission exacts from all utility companies, it was the aim of this commission when the blank forms were formulated to have them agree to requirements adopted by the Interstate Commerce Commission as nearly as possible. Since then we find the need for making some changes in the requirements in order that these more nearly meet those of the Interstate Commerce Commission, thus securing greater uniformity and requiring less work on the part of the utility companies.

Under section 56 of the act creating the Public Utilities Commission, all public utilities are required to report every accident occurring or that may occur to or on its plant, equipment, or other property, of such a nature as to endanger the safety, health, or property of any person. The commission is vested with the power to investigate any accidents and to issue such orders as, in their judgment, are reasonable and which will operate to prevent a recurrence. Up to this time the commission has only covered accidents occurring upon the property of common carriers, street car lines, * * *

KANSAS

Section 32 of our public utility laws does not empower the commission to issue any rules, regulations, or orders in regard to means of safety. The law requires the common carriers and public utilities, whenever an accident occurs attended with loss of human life or serious personal injury, to give immediate notice thereof by telegraphing the commission.

Our common carriers and public utilities are complying with the law in that respect.

This section also empowers the commission, if it deems the public interest requires it, to cause an investigation to be made in connection with the labor commissioner. In

all such cases, where the commission deems it necessary, such investigations are had and a report of the findings of the commission placing the blame for the accident, if any one is to blame, is made.

That is as far as our commission seems to have power to go into the matter of accidents.

So far as I know, investigations are not made by any other State authority of accidents by common carriers or public utilities.

Such of the gas and electric utilities as come under the jurisdiction of the commission report their accidents in compliance with section 32 of the public utility law.

MISSOURI

The commission has issued no general rules or regulations with reference to safety and accidents in connection with the operation of gas and electric utilities in this State.

With reference to reporting of accidents occurring in connection with the operation of gas and electric utilities, please be referred to section 7827, R. S., Mo., 1909, which reads as follows:

"All accidents in manufacturing, mechanical, mercantile, or other establishments or places within this State where labor is employed which prevent the injured person or persons from returning to work within two weeks after the injury, or which result in death, shall be reported by the person in charge of such establishment or place to the factory inspector or deputy inspector, or one of the assistant inspectors provided for by this chapter, and also to the city or county physician, when there be such an officer, which notice may be given by mail."

This section appears to refer to gas and electric utilities.

MONTANA

Neither the railroad commission law nor the public service commission law of Montana gives this department the authority to prescribe methods of operation with a view of promoting safety. We are required, however, to investigate accidents of importance and make report of same to the governor. (Order No. 81, governing reports of accidents of public utilities other than railroads, Jan. 12, 1914.)

NEVADA

The Nevada Industrial Insurance Commission, Carson City, Nev., investigates closely accidents occurring in the operation of gas and electric utilities.

The commission has issued under date of September 15, 1911, Safety regulations for electric utilities.

NEW HAMPSHIRE

Section 15, paragraph (b) of the public utility law, requires all public utilities to report to this commission the accidents to its employees. The commission, however, has never issued any rules, regulations, or orders in connection with this provision. No other State authority has, to our knowledge, any jurisdiction over the investigation of these accidents.

NEW JERSEY

The board requires reports to be made to it of all accidents which may occur in connection with the operation of railroads and street railways. The board, while it has the power under the act to require reports to be made to it of accidents of other utilities, has not so far deemed it necessary to require such reports to be made.

All accidents at gas and electric light plants are reported to the Employers' Liability Commission of this State. Any serious accident occurring in connection with the operation of gas or electric utilities would be investigated by inspectors of this board.

Inspectors of this board are continually visiting plants of gas and electric lighting utilities and conditions discovered as the result of their investigation, which might, if continued, lead to accidents, are reported and corrections required to be made.

NEW YORK, FIRST DISTRICT

The New York Commission, first district, has issued orders as follows:

Order No. 1628 "which has to do with the safeguarding and protecting of employees from injuries by high tension electrical apparatus, or other dangerous conditions." January 13, 1914.

Order No. 1773, dated December 29, 1913, requires "Notice to be given by each gas corporation, electrical corporation, and steam corporation of every accident happening upon its premises, or in connection with the manufacture and distribution of gas, electricity, or steam."

NEW YORK, SECOND DISTRICT

This commission has not issued any rules or regulations governing safety provisions. An order has been made which requires electric and gas corporations to report each accident promptly. After receiving such reports the commission requests such further information or makes such further investigations by its own agents as appear to be advisable.

NORTH CAROLINA

The corporation commission has not taken any action under chapter 127 of the laws of 1913 up to the present time, except to require all public-utility companies covered by said chapter to file with the commission a schedule of charges.

OREGON

This commission, in accordance with section 552 of the public-utility act of this State, requires all accidents to be reported to us, said reports including accidents occurring in the operation of gas and electric utilities. Serious accidents are investigated by the commission.

The commission has issued "General regulations governing overhead and underground construction of telegraph, telephone, signal, trolley, and power lines within Oregon," as amended and effective, May 12, 1914.

PENNSYLVANIA

Accidents occurring in the operation of gas and electric utilities are reported to this commission if they are not considered industrial accidents.

Accidents of an industrial character are reported to the Department of Labor and Industry, Harrisburg, Pa.

1. Report must be filed of all accidents resulting in loss of life or injury to persons, with two exceptions, as follows: (a) No report need be filed to accidents to employees where the incapacitation is for a period of 3 days or less. (b) No report need be filed of accidents to employees which occur in repair shops, construction shops, and other places remote from the line of operation.

2. In case of accident of a serious or unusual character involving death or serious injury to others than trespassers, a telegraphic report must be made at once, followed by the usual written report.

RHODE ISLAND

Relative to the procedure of the commission with reference to safety provisions and accident prevention and investigation, we would say that no general rules or regulations have been established. In one instance the commission made certain

recommendations relative to the protection of grade crossings on an interurban line (p. 81 of the report of the commission for the year 1912).

There is no statute requiring utilities to report accidents to any State authority except this commission and it has been the practice of the commission to informally investigate any accident reported, whenever deemed necessary. Only one formal accident investigation has been conducted by the commission, and that was a joint investigation with the Interstate Commerce Commission of the derailment of a passenger train of the New York, New Haven, & Hartford Railroad Co., at Westerly, on October 25, 1913.

VERMONT

In regard to the matter of safety provisions and accident prevention in this State we beg to say that the Public Service Commission has issued no rules, regulations, or orders on safety and accidents in accordance with section 7 of the acts of 1908. All accidents occurring in the operation of gas and electric utilities in this State are reported to and investigated by the Public Service Commission and not by any other State authority.

WASHINGTON

The commission has issued as yet no rules, regulations, or orders on safety and accidents in accordance with sections 26 and 63 of the public-service commission act. We have two inspectors of safety appliances, tracks, and equipment constantly in the field.

II. METERS AND INSTRUMENTS

The subjects of electrical measuring instruments and methods of testing are discussed in Bureau of Standards' Circular No. 20, revised edition, "Electrical Measuring Instruments," which should be consulted in this connection for full information. Only certain general statements need be made here in so far as they have a bearing on electric service standards.

Electrical measuring instruments, for the purposes of this circular, may be divided into groups as follows:

1. Service meters, for example, watthour meters, amperehour meters, and demand meters.
2. Switchboard and other station instruments, such as ammeters, voltmeters, wattmeters, frequency meters, and recording instruments of various kinds.
3. Laboratory and testing instruments, such as rotating standards (e. g., portable watthour meters); precision voltmeters, ammeters, and wattmeters, standard cells, standard resistances, potentiometers, and other apparatus used for testing purposes.

It is suggested that it will tend to make for uniformity and clearness in discussion if the term "instrument" be restricted to refer particularly to indicating and graphic devices, that is, to devices that indicate the value of an electrical quantity at the time of observation or that make a permanent record of the variations of the quantity with time, and the term "meter" to refer to devices which register on a dial the total energy consumed or delivered to a circuit, or which indicate or leave a record of, the load that has existed in the circuit.

Watthour meters are still at times incorrectly called "wattmeters," "recording wattmeters," or "integrating wattmeters," and although the last can be defended, the term "watthour meter" should be used exclusively. "Wattmeter" and "recording wattmeter" are incorrect when energy measuring devices are meant, and should never be used in that sense, for the device is not recording and is not a wattmeter.

The terms "watts" and "kilowatts" (when watthours and kilowatthours are meant) are not uncommonly used incorrectly in ordinances and franchises still in force.

A recording instrument may be defined, as used in rules and ordinances in this circular, as an instrument leaving a permanent

record. In certain rules such instruments are called "graphic recording" instruments, to call special attention to the curve-tracing or graph-making operation of the instrument.

1. FACILITIES FOR METER TESTING

Commission rules necessarily must be in general terms with reference to the testing equipment and facilities of utilities inasmuch as they are applicable to the largest and smallest alike, unless special exceptions are made in the rules. Exceptions complicate the rules and it seems best to make rules with reference to meter-testing facilities sufficiently general to cover all cases, and have the commission inspect and approve each utility's equipment. Local conditions can in this way be taken care of to better advantage than by specific limits set in the rules themselves.

The distinctions ordinarily made between primary, secondary, and working or test standards are not in all cases clear and are apt to cause confusion. Utilities having so-called laboratory or precision instruments often think and speak of such instruments as primary standards. It seems desirable, therefore, not to refer in particular to primary and secondary standards in rules, but to make a general rule that each utility must have available such equipment, facilities, and apparatus as may be sufficient to carry out the provisions of rules, and have a decision by the commission as to the suitability and adequacy of the apparatus and instruments provided by any utility for its meter work.

The standards used in testing service watthour meters include voltmeters, ammeters, wattmeters, and portable watthour meters, commonly called rotating standards. The apparatus necessary and sufficient for each utility should be determined by the commission in each case. This allows differences in local conditions and practice, as well as giving the smaller utilities the benefit of engineering advice from the commission in an important matter.

The larger utility companies maintain fully equipped standardizing laboratories, in many instances more fully equipped for precision work than many commission laboratories. In such cases definite approval of methods and apparatus and periodic inspection by the commission will insure proper service.

For the utility not maintaining what in the judgment of the commission is a "standardizing laboratory" a certain minimum of testing and checking apparatus should be definitely fixed by service rules. (See p. 152.)

2. THE APPROVAL OF TYPES OF METERS

The laws of New York, Missouri, Washington, and District of Columbia forbid the placing in service of electricity meters the type of which has not been approved by the public-service commission.

The New York law, on which the other laws seem to be based, reads: "No corporation, person, or municipality shall furnish, set, or put in use any electric meter the type of which shall not have been approved by the commission."

The New York Public Service Commission, first district, has issued two orders in what is known as case No. 1099, "Specifications for electric current energy meters," effective July 1, 1909, and an "Order prescribing new specifications, rules, and regulations as to watthour meters," effective October 1, 1913, and repealing the order of 1909. The New York Public Service Commission, second district, has issued Bulletin E-M-1, "Rules and regulations governing acceptance tests of direct-current and single-phase induction watthour meters," adopted June 21, 1911. At this time (1916) no other State commissions have adopted specifications for the approval of types of meters.

The specifications and rules issued by the New York commissions are based to a large extent on the Code for Electricity Meters prepared by the Electrical Testing Laboratories under the instructions of the joint meter committee of the Association of Edison Illuminating Companies and of the National Electric Light Association. This Meter Code was published in 1910, and in a second edition in 1912, and reprinted in 1913.

It seems desirable to have standard specifications for types of meters that may be acceptable alike to State commissions, manufacturers, and operating companies throughout the country. Many companies are to-day operating in several States and may be supervised by several State commissions. Standardization and uniformity are particularly desirable on this account, and it is to be hoped that standard specifications for the approval of types of meters can soon be agreed upon.

The approval specifications for types of meters of the two New York commissions are not alike and also differ from the specifications in the Meter Code (Sec. IV). The Bureau of Standards has conferred with the joint meter committee under whose auspices the Meter Code has been issued, with representatives of State public-service commissions and the manufacturers of meters, and

these specifications are suggested for general acceptance by State commissions. It is believed that the form suggested is a step in the direction making for increased clearness and ease of reference.

The following suggested specifications are so drawn as to cover the approval of types of meters now in service, and the allowances and limits are believed to be wide enough to include all types of meters that are giving good service in use to-day on utilities' lines. It is believed that any types of meters now in use which do not measure up to these specifications should not be approved for continued use by any commission. It should also be clearly understood that new present-day types of meters surpass in many respects the limits set in this specification.

The laws requiring the approval of types of electricity meters are not specific and definite. There are in use on customers' circuits watthour meters, amperehour meters, demand meters, all made in several types and all used in measuring the customer's service. It is not possible to propose a specification to cover approval tests for all these types of meters, but it seems desirable in drawing up a specification for the consideration of public-service commissions to make it broad enough to cover the whole subject in time, even though at present it is not possible to provide specifications for all types of electricity meters.

3. SUGGESTED SPECIFICATIONS GOVERNING APPROVAL TESTS OF TYPES OF ELECTRICITY METERS BY STATE COMMISSIONS

GENERAL PROVISIONS FOR THE APPROVAL OF TYPES OF WATTHOUR METERS BY THE COMMISSION

1. Who May Make Application.—Any electrical utility or municipality may make application to the commission for tests and approval of types of watthour meters intended to be used by it.

2. Form of Application.—The application shall state: (a) The name and address of the applicant; (b) the name and address of the manufacturer of the meter; (c) the manufacturer's type of meter, and a brief description of its characteristics; as direct current or alternating current, frequency, two-wire or three-wire, induction, commutator, or mercury type, etc.

3. Photographs.—The application shall be accompanied by three photographs of the meter—one with the cover in place, one with the cover removed, and one of the moving element removed from its housing or otherwise showing construction. Each photograph shall be 8 by 10 inches in size, and mounted on linen.

4. Shipment of Meters for Test.—Directions for shipment of meters to be tested will be furnished upon application to the commission. All shipment charges shall be prepaid by the applicant.

5. Number of Specimens to be Submitted.—Ten meters shall be submitted as specimens, except in the case of very large meters or meters of unusual or little-used types, when a smaller number as arranged for with the commission may be taken as being representative of the type. These meters shall be so selected as to be representative as far as possible of every size of meter included in the type. In addition to the required number of meters submitted as samples, there shall be submitted, when practicable, a sufficient additional number of the type to serve as a reserve from which replacements may be made when necessary.

6. Similar Types.—All meters included in the same type must be substantially equivalent in the following respects:

- Weight of rotating element.
- Full-load torque.
- Full-load speed.
- Style of bearings.
- Means of adjustment.
- Number of magnets.
- Ampere turns in current coil at rated current.
- Shape and arrangement of magnetic circuits.
- Electric circuits and connections.
- General relation of parts.
- Electrical and magnetic materials.
- Rated frequency.
- Rated voltage.

A three-wire meter is not to be considered as being of the same type as a two-wire meter unless it is in fact similar in all essential details of construction.

In the case of meters constructed and adjusted to be used with current transformers, voltage transformers, or shunts, these specifications apply to the accuracy of the combination.

7. Modification of Types.—(a) The commission shall be advised of each and every modification of a meter type used or intended for use within its jurisdiction. The necessity or desirability of a retest of the type will be determined by the character of the modification.

(b) In the case of meters that are modifications of types which have already been approved, the commission may determine the number that shall be submitted and to which of the following tests they shall be subjected.

(c) Meters so designed as to preclude their conforming to one or more of the requirements as set forth in this specification may be submitted to the commission with a statement setting forth the facts, and such meters will be subjected to tests as may be deemed necessary.

8. Recording and Indicating Devices.—Recording and indicating devices operated by or in connection with watthour meters must be approved for use in connection with the type of watthour meter used.

SPECIFICATIONS FOR DESIGN AND CONSTRUCTION

9. Type and Serial Number.—Each meter shall be designated by type, and given a serial number by the manufacturer, to identify it as an individual. The serial number and type designation shall be legibly marked on the base, name plate, or frame of each meter, in such a manner as to be visible when the meter is in service. The register ratio shall be marked on a permanent part of the register.

10. Fixed and Adjustable Parts.—All fixed parts shall be held securely in a permanent relationship. All adjustable parts shall be so constructed that they can be released without injuring the parts of the meter, can be easily moved through the requisite distance, and can be securely fastened in place.

11. Accuracy and Range of Adjustment.—The meter shall be designed to facilitate necessary connecting, adjusting, repairing, and testing. All connections and such parts as require adjustment in service shall be easily accessible after removing the cover. The adjustments of the meter shall be such as to be capable of making the meter accurate within 1 per cent when the current is 10 per cent and 100 per cent of rated current. The range of each adjustment shall be such as to permit the meter to be adjusted so as to register correctly under all ordinary conditions met with in service.

12. Cover.—The cover of the meter shall be sufficiently strong to withstand all ordinary usage. It must be dust proof and suitable means for sealing must be provided.

13. Terminals.—The terminals of the meter shall be so arranged that the liability of making short circuits in removing or replacing the cover, making connections, and adjusting the meter is minimized.

14. Maintenance of Accuracy.—The meter shall be designed and constructed with special attention to maintained accuracy and to prevent tampering.

PRELIMINARY PREPARATION OF METERS FOR TESTS

15. Initial Inspection.—Upon receipt of the sample meters submitted for test they will be inspected for injuries received in transportation. Damaged meters will be replaced from the reserve meters.

16. Adjustments by Owners or Manufacturers.—(a) The applicant submitting a type of meter for test and approval, and the manufacturer of the meter, will be notified by the commission of the place and time of test, and may have representatives present to adjust the meters.

(b) When the meters are set up for test a representative of the applicant or the manufacturer will be permitted to adjust the meters. Any means of adjustment which is recognized as a standard method for the given type of meter may be used. Methods of adjustment which can not be conveniently applied in the ordinary commercial use of the meter will not be permitted. Structural changes in the meter will not be permitted.

(c) Upon the failure of the applicant or manufacturer to have a representative present during the preparations for test, the commission's representative will adjust the meters.

(d) If the adjustment discloses defects not discovered in the preliminary inspection, the defective meter may be replaced, at the discretion of the commission's representative. Such replacement, however, will not be made unless the defect be of a definite and specific nature, and be capable of ready detection by methods other than that of an accuracy test upon the meter.

(e) Any damage resulting from shipment or defect as specified above which may be repaired by the replacement of an interchangeable part may, at the discretion of the commission's representative, be so repaired without replacing the individual meter.

(f) When the party adjusting the meters pronounces them ready, or when the commission's representative considers that sufficient time has been allowed, the meters shall be formally turned over to the commission's representative for test. No representative of the applicant or the manufacturer shall be allowed access to the meters thereafter, and no further readjustment shall be made. Such representatives may, however, witness the tests, and shall be furnished reasonable facilities for obtaining information as to the conduct and the results of the tests. Meters may be withdrawn from test by the applicant at the discretion of the commission.

17. Preliminary Conditions.—(a) The average room temperature during the calibration of the meters shall be taken as the

standard temperature for the subsequent tests. In case tests are made when the room temperature differs from the standard temperature a suitable allowance may be made in the results for variations caused thereby. The standard temperature should not be below 15°C nor above 30°C .

(b) The registers of the meters shall be in train during the tests.

(c) Meter covers, where possible, shall be in place during all tests, and may be sealed.

(d) Three-wire meters shall be tested with their current coils in series, except when the equality of the coils is being checked.

(e) Polyphase meters subjected to single-phase tests shall be tested with their current coils in series and their voltage coils in parallel.

(f) The voltage applied during the adjustments of the meters shall be known as the calibration voltage.

18. Interim Conditions.—The official tests shall be begun after all of the conditions have been complied with, and not less than one hour nor more than two hours after the adjustment of the meters has been completed. In the interval, the meters shall operate at 10 per cent of their rated loads. Test No. 1 shall be made on the same day the adjustments are completed.

19. Order and Conditions of Tests.—(a) The tests and the items of each test shall be conducted in the order given.

(b) All tests shall be made at calibration voltage unless otherwise stated. All tests of alternating-current meters shall be made at rated frequency and unity power factor unless otherwise stated.

(c) After each change in voltage, or load, a sufficient time interval shall be allowed for the meter to come to a steady state before making the next observation or test.

20. Creep.—For the purpose of approval tests, a meter is considered to creep if, with the load wires removed, and with voltage applied to the meter, the moving element rotates continuously, making at least one complete rotation in 15 minutes.

21. Registration.—The registration of a meter is the total amount of energy which has been recorded since the meter was set at zero; or, in some cases, the difference between two such readings at the beginning and end of a particular period, in which case it is the energy in kilowatt hours recorded in the given interval.

The rate of registration in meter testing is the registration in a unit of time. It may be expressed in kilowatts, in watts, or in any convenient arbitrary unit, as, for example, the number of revolutions of the moving element per minute. If expressed in

per cent, it is the rate as compared with a perfectly accurate meter or with standard instruments which measure the power.

CONDITIONS GOVERNING THE APPROVAL AND REJECTION OF TYPES

22. In no case shall a meter be considered to fall outside of the specified limits in any item depending upon a determination of the accuracy of the meter, unless the specified limit is exceeded by the amount of one-quarter per cent, which is the value assigned to cover possible errors in the standards employed and in the observations.

23. If, during the test of a meter type, 3 meters of the 10 submitted have to be replaced, due to physical defects which become apparent during the tests, the type shall be rejected.

24. In the tests made on 10 meters, not over 3 meters shall fail in a given item of a given test, and the total number of failures, including all the meters and all the items of each test, shall not exceed 20. No individual meter shall fail in more than five items.

25. When less than 10 meters are submitted for test, no meter shall fail in any item in such tests.

At the request, however, of the applicant or manufacturer, or when in the judgment of the commission's representative the results on fewer than 10 meters are unreliable, the tests shall be repeated on 10 meters.

SPECIFICATIONS FOR THE TESTING OF DIRECT-CURRENT WATTHOUR METERS

All tests shall be made at calibration voltage unless otherwise stated.

26. **Test No. 1: Initial Accuracy of Registration.**—1. No meter shall fail to run continuously with 2 per cent of rated current at calibration voltage.

After running for at least one hour at 10 per cent of rated current, as specified in section 18, the meter under test shall be accurate in its registration within the amount specified below.

Item No.	Per cent of rated current	Maximum error in registration in per cent
2.....	5.0	± 7.5
3.....	10.0	± 3.0
4.....	20.0	± 2.0
5.....	50.0	± 2.0
6.....	100.0	± 2.0
7.....	150.0	± 2.0

8. The algebraic difference between the error at 10 per cent rated current and that of 100 per cent rated current shall not exceed 4 per cent.

27. Test No. 2: Effect of Variation of Voltage.—1. No meter shall creep at 110 per cent of calibration voltage.

The effect of variation of voltage upon the registration of a meter carrying constant load in watts shall not exceed that specified below, provided that only meters with a voltage rating extending over a range greater than 15 per cent of calibration voltage shall be subjected to the last four items of this test.

After each change of voltage a sufficient time interval shall be allowed for the meter to come to a steady state before making the next comparative test.

Item No.	Per cent rated watts	Maximum per cent deviation in registration due to variation in voltage with constant load
2. Ninety per cent of calibration voltage.....	10.0	±5.0
3. Ninety per cent of calibration voltage.....	100.0	±2.0
Reference performances (100 per cent of calibration voltage).....	10.0 100.0	..... .....
4. One hundred and ten per cent of calibration voltage.....	10.0	±5.0
5. One hundred and ten per cent of calibration voltage.....	100.0	±2.0
6. Ninety-five per cent of minimum marked voltage.....	10.0	±5.0
7. Ninety-five per cent of minimum marked voltage.....	100.0	±2.0
8. One hundred and five per cent of maximum marked voltage.....	10.0	±5.0
9. One hundred and five per cent of maximum marked voltage.....	100.0	±2.0

28. Test No. 3: Equality of Current Coils in Three-wire Meters.—

The change produced in the registration of a meter by using only one current coil (carrying a double current) over that when both current coils are used shall not exceed that specified below. The term current coil is understood to mean the path of the main current through the meter, and with this understanding it applies to mercury meters.

Item No.	Connections	Per cent rated current	Maximum per cent deviation in registration due to use of only one current coil carrying double current
Reference performance.....	Both coils.....	10.0	.....
1.....	Coil A only.....	20.0	±2.0
2.....	Coil B only.....	20.0	±2.0
Reference performance.....	Both coils.....	50.0	.....
3.....	Coil A only.....	100.0	±2.0
4.....	Coil B only.....	100.0	±2.0

29. Test No. 4: Effect of External Magnetic Field.—The change produced in the registration of a meter at 20 per cent of rated current by the application in the manner stated of an external magnetic field of the value given below shall not exceed 2.5 per cent.

An approximately uniform magnetic field of 0.25 gauss shall be applied to one of the meters submitted, in such a direction as to have the maximum effect upon the registration of the meter.

An apparatus for producing an approximately uniform magnetic field may be constructed by winding two coils rectangular in cross section on the edges of two circular disks supported in two vertical planes with their axis common and with the mean distance between the coils equal to the mean radius of the coils. The coils are connected in series so that the direction of winding is the same when passing from one to the other. The field strength will be proportional to the current and practically uniform throughout the space between the coils.

30. Test No. 5: Effect of Variation in Temperature.—The test shall be applied to not less than three meters.

(a) The average temperature coefficient shall not exceed 0.2 per cent per degree centigrade at either 10 per cent or 100 per cent rated current. The per cent difference in the rate of registration of the meter at the higher temperature from that at the lower temperature divided by the difference in temperature is the temperature coefficient.

The meter shall be placed in a space having a temperature of approximately 20° C, or room temperature as specified in section 17 (a), and allowed to stand for not less than two hours with the voltage circuit of the meter energized. A load of 10 per cent of the rated current shall then be applied, and after running for one hour the meter shall be tested at this load. A load of 100 per cent of the rated current of the meter shall then be applied for one hour and the meter again tested at this load. These operations shall be repeated in the same order at a temperature approximately 20° C higher.

For meters having external shunts the temperature coefficient shall not exceed 0.25 per cent per degree centigrade when the shunt and the meter have equal temperature.

(b) For meters having external shunts with connecting leads more than 5 feet in length the effect of unequal heating of the shunt and meter shall be determined in a manner similar to the

determination of temperature coefficient in (a) above, first, with meter, shunt, and leads connecting shunt and meter, in a space at approximately 20° C, to be used as reference performance; second, with the meter and one-half the length of the leads in a space at approximately 20° C, the shunt and the other half of the leads in a space approximately 20° C higher; and, third, with the meter and one-half the length of the leads in a space at approximately 40° C and the shunt and other half of the leads in a space approximately 20° C lower.

The change in the rate of registration shall not exceed 0.25 per cent per degree centigrade inequality of temperature.

31. Test No. 6: Effect of Temporary Overloads.—The effect of temporary overload upon the registration of meters of less than 600 amperes capacity shall not exceed the values given below. A temporary load of ten times the rated current of the meter shall be applied three times to each meter under test, the duration of each overload being approximately two seconds. Each meter shall be tested with 10 per cent of rated current and 100 per cent of rated current before the application of the overload and again afterwards.

The maximum per cent deviation in registration due to the temporary overload shall not be greater than 5 per cent at 10 per cent of rated current (item 1), nor greater than 3 per cent at 100 per cent of rated current (item 2).

32. Test No. 7: Voltage Drop or Watts Loss in Current Coils.—The voltage drop or watts loss in the current coils of each meter shall be measured at 100 per cent of rated current.

In meters of 25 amperes or less capacity, the loss shall not exceed 15 watts.

In meters of more than 25 amperes capacity, the drop shall not exceed 0.4 volt.

SPECIFICATIONS FOR THE TESTING OF SINGLE-PHASE INDUCTION WATTHOUR METERS

All tests of alternating-current meters shall be made at calibration voltage, rated frequency, and unity power factor, unless otherwise stated.

33. Test No. 1: Initial Accuracy of Registration.—I. No meter shall fail to run continuously with 2 per cent of rated current at calibration voltage.

After running for at least one hour at 10 per cent of rated current, as specified in section 18, the meter under test shall be accurate in its registration within the amounts specified below.

Item No.	Per cent rated current	Maximum error in registration in per cent
2.....	5.0	± 3.0
3.....	10.0	± 1.5
4.....	20.0	± 2.0
5.....	50.0	± 2.0
6.....	100.0	± 1.5
7.....	150.0	± 3.0

8. The algebraic difference between the error at 10 per cent rated current and that at 100 per cent rated current shall not exceed 2 per cent.

34. Test No. 2: Effect of Variation of Voltage.—1. No meter shall creep at 110 per cent of calibration voltage.

The effect of variation of voltage upon the registration of a meter carrying constant load in watts shall not exceed that specified below, provided that only meters with a voltage rating extending over a range greater than 15 per cent of calibration voltage shall be subjected to the last four items of the test.

Item No.	Per cent rated watts	Maximum per cent deviation in registration due to variation of voltage with constant load
2. Ninety per cent of calibration voltage	10.0	± 2.0
3. Ninety per cent of calibration voltage	100.0	± 1.5
Reference performances (100 per cent of calibration voltage)	10.0	.....
	100.0	.....
4. One hundred and ten per cent of calibration voltage	10.0	± 2.0
5. One hundred and ten per cent of calibration voltage	100.0	± 1.5
6. Ninety-five per cent of minimum marked voltage	10.0	± 2.0
7. Ninety-five per cent of minimum marked voltage	100.0	± 1.5
8. One hundred and five per cent of maximum marked voltage	10.0	± 2.0
9. One hundred and five per cent of maximum marked voltage	100.0	± 1.5

35. Test No. 3: Effect of Variation of Power Factor.—The effect of variation of power factor upon the registration of a meter carrying constant load shall not exceed that specified below. In the case of a polyphase meter tested with single-phase load, the test shall be made on each element separately, but with the voltage coils of both elements energized.

Item No.	Per cent rated current	Per cent power factor lagging	Maximum per cent deviation in registration due to variation of power factor
Reference performance.....	10.0	100.0	.....
1.....	13.3	75.0	± 2.0
2.....	20.0	50.0	± 4.0
Reference performance.....	100.0	100.0	.....
3.....	100.0	75.0	± 2.0
4.....	100.0	50.0	± 4.0

36. Test No. 4: Effect of Variation of Frequency.—The effect of variation of frequency upon the registration of a meter carrying constant load shall not exceed that specified below.

Item No.	Per cent rated current	Per cent rated frequency	Maximum per cent deviation in registration due to variation of frequency
Reference performance.....	10.0	100.0	.....
Do.....	100.0	100.0	.....
1.....	10.0	95.0	± 1.5
2.....	100.0	95.0	± 1.5
3.....	10.0	105.0	± 1.5
4.....	100.0	105.0	± 1.5

37. Test No. 5: Equality of Current Coils of Three-Wire Meters.—The change produced in the registration of a meter by using only one current coil (carrying a double current) over that when both current coils are used shall not exceed that specified below.

Item No.	Connections	Per cent rated current	Maximum per cent deviation in registration due to use of only one current element carrying double current
Reference performance.....	Both coils.....	10.0	.....
1.....	Coil A only.....	20.0	± 2.0
2.....	Coil B only.....	20.0	± 2.0
Reference performance.....	Both coils.....	50.0	.....
3.....	Coil A only.....	100.0	± 2.0
4.....	Coil B only.....	100.0	± 2.0

38. Test No. 6: Effect of External Magnetic Fields.—The change produced in the registration of a meter at 10 per cent of rated current by the application of an external magnetic field in the manner stated shall not exceed 2.5 per cent. One of the meters shall be subjected to an alternating magnetic field of the same frequency as that of the testing current and produced by a straight conductor 6 feet long, with return leads arranged to form a rectangle 6 feet square. A current of 50 amperes in phase with the voltage applied to the meter shall be passed through this conductor. The return leads of the conductor shall be so arranged that the loop which they form does not surround or include the meter.

Place the straight 6-foot conductor in each of the following positions:

1. Behind the test board in a horizontal position and parallel to the back of the meter. The middle of the conductor shall be 15 inches directly behind and on a level with the center of the rotating element.

2. Directly behind the center line of the meter in a vertical position. The middle of the conductor shall be 15 inches directly behind and on a level with the center of the rotating element. The loop shall be in plane perpendicular to the test board.

3. Vertically at the same distance in front of the test board as the center of the rotating element. The middle of the conductor shall be on a level with the center of the rotating element and 15 inches to the right or left. The loop shall be in a plane parallel to the test board.

39. Test No. 7: Effect of Variation in Temperature.—This test shall be applied to not less than three meters. The average temperature coefficient shall not exceed 0.2 per cent per degree centigrade at either 10 per cent or 100 per cent of rated current. The per cent difference in the rate of registration of the meter at the higher temperature from that at the lower temperature divided by the difference in temperature is the temperature coefficient.

The meter shall be placed in a space having a temperature of approximately 20° C or room temperature, as specified in section 17 (a), and allowed to stand for not less than two hours with the voltage circuit of the meter energized. A load of 10 per cent of the rated current shall then be applied, and after running for one hour the meter shall be tested at this load. A load of 100 per

cent of rated current shall then be applied for one hour and the meter again tested at this load.

These operations shall be repeated in the same order at a temperature approximately 20° C higher.

40. Test No. 8: Effect of Temporary Overloads.—The maximum percentage deviation in registration of a meter due to temporary overload shall not exceed 1 per cent at 10 per cent of rated load (item 1) and 100 per cent of rated load (item 2).

A temporary load of ten times the rated current shall be applied three times to each meter under test, the duration of each overload being approximately two seconds. The overload current shall be approximately in phase with the voltage applied to the voltage circuit of the meters.

Each meter shall be tested with 10 per cent of rated current and 100 per cent of rated current before the application of the overload, and again afterwards.

41. Test No. 9: Voltage Drop or Watts Loss in Current Coils.—The voltage drop or watts loss in the current coils of each meter shall be measured at 100 per cent of rated current.

In meters of 25 amperes or less capacity the loss shall not exceed 5 watts.

In meters of more than 25 amperes capacity the drop shall not exceed 0.15 volt.

SPECIFICATIONS FOR THE TESTING OF POLYPHASE WATTHOUR METERS

All tests of alternating current meters shall be made at calibration voltage, rated frequency, and unity power factor, unless otherwise stated.

42. General.—In case the preliminary adjustment of the meter is made upon a polyphase load, the relation of the phases used in the preliminary adjustment shall be maintained in all subsequent tests.

The two-phase test is to be used in the case of all meters, except such as successfully pass test No. 1, or are designed or designated as three-phase meters, which are to be submitted to the corresponding three-phase tests.

In the case of a three-phase four-wire meter, all elements shall be subjected to the same requirements as to equality as are specified for a meter having two elements.

43. Test No. 1: Independence of Elements.—The maximum per cent deviation in registration under the load conditions given in the table below shall not exceed the values specified.

Each meter shall be tested on a two-phase circuit.

Throughout the test the voltage and current windings of one element (element A) of the meter are connected to phase I of the two-phase circuit. The other element (element B) is connected as indicated. In the current tests, under items 3 and 4, the currents in both elements shall be equal.

Item No.	Connections of element B		Maximum per cent deviation in registration	
	Voltage circuits	Current circuits	Twenty per cent of rated current on element A	One hundred per cent of rated current on element A
			Per cent	Per cent
Reference performance.....	Phase I correct.....	Not connected.....		
1.....	Phase I reversed.....	do.....	±1.0	±1.0
Reference performance.....	Phase II correct.....	do.....		
2.....	Phase II reversed.....	do.....	±1.0	±1.0
Reference performance.....	Not connected.....	Phase I correct.....		
3.....	do.....	Phase I reversed.....	±1.0	±1.0
Reference performance.....	do.....	Phase II correct.....		
4.....	do.....	Phase II reversed.....	±1.0	±1.0

If every meter of a given type conforms to each of the requirements of this test, the further tests shall be made on a single-phase circuit, using the specifications laid down for a single-phase three-wire meter.

In case one or more meters fail in any of the requirements of this test, the approval tests of the type to which such meters belong shall be made on a polyphase circuit according to the specifications following.

44. Test No. 2: Initial Accuracy of Registration—Both Elements in Circuit.—1. No meter shall fail to run continuously with 2 per cent of rated current at calibration voltage.

After running for at least one hour at 10 per cent of rated current, as specified in section 18, the meter under test shall be accurate in its registration within the amount specified below. Each meter shall be tested with a balanced polyphase load, both elements being in circuit.

Item No.	Per cent rated current	Maximum error in registration in per cent
2.....	5.0	±3.0
3.....	10.0	±1.5
4.....	20.0	±2.0
5.....	50.0	±2.0
6.....	100.0	±1.5
7.....	150.0	±3.0

8. The algebraic difference between the error at 10 per cent rated current and that at 100 per cent rated current shall not exceed 2 per cent.

45. Test No. 3: Equality of Individual Elements.—The change produced in the registration of a meter by using only one meter element (carrying a double current) over that when both elements are in circuit shall not exceed that specified below.

In the case of a two-phase test, the test on each element shall be made at unity power factor. In the case of a three-phase test, a balanced three-phase load shall be obtained in the testing circuit, so that the test upon each element is made with the same conditions as those existing when both elements are connected to a balanced polyphase circuit in which the power factor is unity.

The voltage coils of each meter shall be energized continuously from a polyphase circuit.

Item No.	Corrections meter element	Per cent rated current	Maximum per cent deviation in registration due to use of one meter element only
Reference performance.....	Both elements in circuit.....	10.0	.....
1.....	Element A only.....	20.0	±2.0
2.....	Element B only.....	20.0	±2.0
Reference performance.....	Both elements in circuit.....	100.0	.....
3.....	Element A only.....	140.0	±2.0
4.....	Element B only.....	140.0	±2.0

46. Test No. 4: Effect of Variation of Voltage.—1. No meter shall creep at 110 per cent of calibration voltage, with the voltage coils connected to a balanced polyphase circuit.

The effect of variation of voltage upon the registration of a meter carrying constant load in watts shall not exceed that specified below, provided that only meters with a voltage rating

extending over a range greater than 15 per cent of calibration voltage shall be subjected to the last four items of this test.

Each meter shall be tested with a balanced polyphase load at the various values of current and voltage given below.

Item No.	Per cent rated watts	Maximum per cent deviation in registration due to variation of voltage with constant load
2. Ninety per cent of calibration voltage.....	10.0	± 2.0
3. Ninety per cent of calibration voltage.....	100.0	± 1.5
Reference performances (100 per cent of calibration voltage).....	10.0	.....
	100.0	.....
4. One hundred and ten per cent of calibration voltage.....	10.0	± 2.0
5. One hundred and ten per cent of calibration voltage.....	100.0	± 1.5
6. Ninety-five per cent of minimum marked voltage.....	10.0	± 2.0
7. Ninety-five per cent of minimum marked voltage.....	100.0	± 1.5
8. One hundred and five per cent of maximum marked voltage.....	10.0	± 2.0
9. One hundred and five per cent of maximum marked voltage.....	100.0	± 1.5

47. Test No. 5: Effect of Variation of Power Factor—Individual Elements.—(a) **TWO-PHASE TESTS.**—The effect of variation of power factor upon the registration of a meter carrying constant load shall not exceed that specified below. Each meter shall be tested with the voltage coils connected to a balanced polyphase circuit, but with load upon only one current coil, at the values of current and power factor specified.

EACH ELEMENT

Item No.	Per cent rated current	Per cent lagging power factor	Maximum per cent deviation in registration due to variation of power factor
Reference performance.....	20.0	100.0	.....
1.....	26.7	75.0	± 2.0
2.....	40.0	50.0	± 4.0
Reference performance.....	150.0	100.0	.....
3.....	150.0	75.0	± 2.0
4.....	150.0	50.0	± 4.0

(b) **THREE-PHASE TESTS.**—Each meter shall be tested with the voltage coils connected to a balanced polyphase circuit, but with load on only one current coil.

LEADING ELEMENT

Item No.	Per cent rated current	Per cent power factor	Maximum per cent deviation in registration due to variation of power factor
Reference performance.....	23.1	86.6 leading...	.....
1.....	20.0	100.....	± 1.5
2.....	23.1	86.6 lagging...	± 3.0
Reference performance.....	150.0	86.6 leading...	.....
3.....	150.0	100.....	± 1.5
4.....	150.0	86.6 lagging...	± 3.0

LAGGING ELEMENT

Reference performance.....	23.1	86.6 lagging...	.....
5.....	40.0	50.0 lagging....	± 3.0
Reference performance.....	150.0	86.6 lagging....	.....
6.....	150.0	50.0 lagging....	± 3.0

48. Test No. 6: Effect of Variation of Power Factor—Both Elements in Circuit.—The effect of variation of power factor upon the registration of the meter carrying constant load shall not exceed that specified below. Each meter shall be tested on a balanced polyphase circuit.

Item No.	Per cent rated current	Per cent lagging power factor	Maximum per cent deviation in registration due to variation of power factor
Reference performance.....	10.0	100.0	.....
1.....	13.3	75.0	± 2.0
2.....	20.0	50.0	± 4.0
Reference performance.....	100.0	100.0	.....
3.....	100.0	75.0	± 2.0
4.....	100.0	50.0	± 4.0

49. Test No. 7: Effect of Variation of Frequency.—The effect of variation of frequency upon the registration of a meter carrying constant load shall not exceed that specified below. Each meter shall be tested with a balanced polyphase load.

Item No.	Per cent rated current	Per cent rated frequency	Maximum per cent deviation in registration due to variation of frequency
Reference performance.....	10.0	100.0	.....
Do.....	100.0	100.0	.....
1.....	10.0	95.0	± 1.5
2.....	100.0	95.0	± 1.5
3.....	10.0	105.0	± 1.5
4.....	100.0	105.0	± 1.5

50. Test No. 8: Effect of External Magnetic Fields.—The change produced in the registration of a meter with a balanced polyphase load at 10 per cent of rated current by the application of an external magnetic field, in the manner stated in section 38, shall not exceed 2.5 per cent.

One meter shall be subjected to an alternating magnetic field, as is specified in section 38, first with the current in the external conductor in phase with the voltage applied to one element of the meter, and then with this current in phase with the voltage applied to the other element of the meter.

51. Test No. 9: Effect of Variation of Temperature.—This test shall be applied to not less than three meters. The temperature coefficient shall not exceed 0.15 per cent per degree centigrade at either 10 per cent or 100 per cent of rated current. The per cent difference in the rate of registration of the meter at the higher temperature from that at the lower temperature, divided by the difference in temperature, is the temperature coefficient.

The meter shall be placed in a space having a temperature of approximately 20° C or room temperature, as specified in section 17 (a), and allowed to stand for not less than two hours with the voltage circuit of the meter energized. A load of 10 per cent of the rated current shall then be applied, and after running for one hour the meter shall be tested at this load. A load of 100 per cent of rated current shall then be applied for one hour and the meter again tested at this load. These operations shall be repeated in the same order at a temperature approximately 20° C higher.

52. Test No. 10: Effect of Temporary Overloads.—The maximum percentage deviation in registration of a meter due to temporary overload shall not exceed 1 per cent at 10 per cent of rated load (item 1) and 100 per cent of rated load (item 2).

A temporary load of ten times the rated current shall be applied three times to each meter under test, the duration of each overload being approximately two seconds. The overload current shall be approximately in phase with the voltage applied to the voltage circuit of the meter.

Each meter shall be tested with 10 per cent of rated current and 100 per cent of rated current before the application of the overload, and again afterwards.

53. Test No. 11: Voltage Drop or Watts Loss in Current Coils.—The voltage drop or watts loss in the current coils of each meter shall be measured at 100 per cent of rated current.

In meters of 25 amperes or less capacity, the loss in the current coils of each element shall not exceed 5 watts.

In meters of more than 25 amperes capacity, the drop in the current coils of each element shall not exceed 0.15 volt.

4. AMPEREHOUR METERS

At the present time wide differences of opinion exist with reference to the accuracy and suitability for general service of ampere-hour meters.

The meter committee of the National Electric Light Association in its report for 1912³⁷ calls attention to the desirability of having a cheap meter.

It would seem that a meter cheaper than the ones now in use, especially for continuous currents, is an absolute necessity. Apparently the hope of such a continuous current meter must be based on an amperehour meter rather than a watthour meter. The objection to the use of an amperehour meter rests entirely on the fact that it does not take into account the voltage variations of the circuit and consequently the difference between the voltage for which the meter is calibrated and the service voltage might cause an error additional to any error arising in the meter itself. It is, consequently, necessary to know not only the accuracy of the meter but the average voltage of the circuit on which it is used, to determine the accuracy of the registration.

While the voltage regulation in some companies is doubtless so good as to permit of the use of an amperehour meter without its accuracy of registration falling outside the limit now prescribed in States where this matter is regulated, in many companies there are likely to be parts of the system where the voltage at times varies above or below the usual limits prescribed for meter accuracy.

On the other hand it has been urged that lack of familiarity with amperehour meters is the cause of much objection. Large numbers of amperehour meters are used in England,³⁸ France, and Germany, and give satisfactory service. Again, it is said that direct-current circuits are very well regulated as a rule so that the accuracy of amperehour meters on such circuits may be as good as that of watthour meters.

The New York Commission, second district, issued an order on July 3, 1913, as follows:³⁹

Whereas, commutator type meters, when used on alternating-current circuits, are inaccurate and subject to change in degree of accuracy, and amperehour meters do not record energy on commercial electric circuits, except by uncertain deviation, owing to variations in voltage; it is therefore ordered:

1. That on and after July 1, 1915, no corporation, person or municipality within the jurisdiction of this commission shall furnish, set or keep in use any commutator type, watthour meter for the purpose of measuring electric energy on alternating-current circuits, as a basis for computing bills.

³⁷ National Electric Light Association, thirty-fifth convention, vol. 3, p. 25.

³⁸ For house service the watthour meter is not popular in England, the amperehour meter being in much greater demand. (Brooks, *Electrical Instruments and Meters in Europe*, p. 8.)

³⁹ 1913 report, p. 86, vol. 1, New York Public Service Commission, second district.

2. That on and after July 1, 1915, no corporation, person or municipality within the jurisdiction of this commission shall furnish, set, or keep in use any type of electric meter, the readings of which are used as a basis for computing bills, which shall be of such design and construction that its action and registration depend wholly upon the current in the circuit and not upon the energy (amperehour meters).

3. That every person, corporation, or municipality having in service on July 15, 1913, any meters of the types herein prohibited, shall file statements with the commission as follows: Each statement shall show:

(a) Number of commutator type meters owned by respondent which are in use on alternating-current circuits for the purpose of computing bills;

(b) Number of "amperehour" meters owned by respondent which are in use for the purpose of computing bills.

Statements to be filed
on or before—

August 15, 1913.

May 1, 1914.

February 1, 1915.

August 1, 1915.

Giving information
as of—

July 15, 1913.

April 1, 1914.

January 1, 1915.

July 1, 1915.

Provided that if any statement shall show that respondent has no meters of the types herein prohibited in service on the date for which such statement is given, such respondent shall not be required to file any subsequent statements.

On March 25, 1914, the commission issued an order as follows:

By order dated July 3, 1913, this commission prohibited the use of certain types of electric meters in the second public-service district of the State of New York on and after July 1, 1915. Some question has been raised as to the exact interpretation which should be made of such order.

Ordered: 1. That the prohibition of meters, the registration of which depends upon the current in the circuit and not upon the energy, shall apply to integrating (ampere-hour) meters, and not apply to meters used to determine the maximum current or power used on the circuit.

Ordered: 2. That the disapproval of amperehour meters shall not be understood as indicating that this commission would not approve the use of a thoroughly satisfactory amperehour meter, under conditions such that it could be relied upon to give a reasonably accurate record of the energy consumed.

The Wisconsin Railroad Commission has made special interpretation of its rules in the case of electrolytic amperehour meters,⁴⁰ and has held in part as follows in its opinion dated November 23, 1911:

In order to comply with rules 14 and 15 it is necessary to place the oil film over the surface of the electrolyte and keep the cover and stopper on the meter whenever the meter is in service.

In order that the error in registration due to voltage variations may be determined, and also that there may be full compliance with rule 23, voltage records shall be carefully taken in each locality at least once every three months, or whenever changes are made, and proper correction shall be applied to all bills rendered.

A station log shall be kept giving the readings of all indicating instruments on the station's switchboard at least once every hour, and oftener during the hours when the lighting load is changing rapidly.

The correction constant for voltage shall appear upon the consumer's bill together with the meter readings.

⁴⁰ Eighth report, W. R. C., p. 270.

It seems obvious that meter practice in so far as amperehour meters are concerned, is in a formative state, tending, however, toward the increased use of cheap amperehour meters, particularly for small consumers.

5. DEMAND METERS

Devices for indicating and recording the "maximum demand" of consumers' installations are still in an experimental stage of development, and there is a wide variation in practice and opinion with reference to them. Such devices are classified by the meter committee of the National Electric Light Association as follows:

A maximum-demand device is one which indicates or leaves a record of the maximum load which has existed in the circuit, limits the supply, or differentiates the consumption with reference to a fixed value of demand or period of time.

Maximum-demand devices are not yet in wide general use, though there is a widespread interest in such devices. The Board of Gas and Electric Light Commissioners of Massachusetts has investigated the operation of certain types of demand meters to "determine whether or not it is expedient to regulate or prohibit the use of such meters."⁴¹

The use of demand meters, as pointed out in that report, is directly and intimately associated with differential rates for electric service. The question of rates is not discussed in this Circular, and only the accuracy and reliability of the devices used are of interest in this connection, as is also the case in the report of the Massachusetts commission above cited. It is found by that commission that if "properly constructed and calibrated, and properly handled and inspected by the companies' employees while in use upon customers' premises, they may be expected to operate correctly within certain reasonable limits." The board, however, further says:

The board is equally convinced that it is not practicable to test and seal these appliances in the manner long pursued with respect to gas meters, or to apply the methods employed in the periodic adjustment, examination, testing, and sealing of balances, weights, and measures.

The recommendation of the commission, that the provisions of sections 36, 37, and 38 of chapter 141 of the revised laws of Massa-

⁴¹ Twenty-eighth annual report, Board of Gas and Electric Light Commissioners of Massachusetts, 1912, p. 322a and following.

chusetts be extended to include demand meters, was enacted into law and became effective April 6, 1912. (See p. 214 for these sections.)

In the past few years manufacturers have been developing new types of demand-measuring devices, several of which are ready to be placed on the market. Their reliability and accuracy are being investigated by the meter committees of several associations of operating companies.⁴² No specifications as to type can as yet be drawn up for these devices.

⁴² See particularly the reports of the meter committees of the National Electric Light Association and of the Association of Edison Illuminating Companies.

III. STANDARDIZING LABORATORIES OF STATE PUBLIC-SERVICE COMMISSIONS

It has been thought desirable to collect and present in concise form information furnished by commissions concerning the electrical standardizing laboratory equipment provided by them.

The replies made by commissions, here arranged in alphabetical order, indicate that standard apparatus for testing the commonly used types of service meters is now available in a number of commission laboratories or college and university laboratories co-operating with the State public service commissions.

This survey of the laboratory equipment of the several commissions may be of value to other commissions about to equip laboratories in suggesting necessary and desirable apparatus. The Bureau of Standards will be pleased to advise and assist commissions, municipalities, and utilities in establishing laboratories when requested to do so. The State commissions not included below have not yet established standardizing laboratories (1915).

DESCRIPTION OF COMMISSION LABORATORIES

CONNECTICUT

The laboratory equipment of the Connecticut Public Utilities Commission is at Trinity College, Hartford, but is the property of the State. An officer of the college is in charge of the laboratory for the commission.

The following apparatus is available:

Potentiometer, standard cells, galvanometer, storage battery, standard resistances, and wheatstone bridge. Standard voltmeter with ranges 15 to 600 volts. Standard millivoltmeter with shunts for current measurement from 1.5 to 600 amperes. Standard indicating alternating current and direct current wattmeters, portable polyphase wattmeters, single-phase and polyphase rotating standard watthour meters.

Portable voltmeters and millivoltmeters with necessary multiples and shunts, voltage and current transformers, meter-testing resistance load, rheostats, phantom loads, etc.

DISTRICT OF COLUMBIA

The commission has not yet established an electrical standardization laboratory, but has provided itself with portable instruments which are used in making tests of watthour meters upon request. These instruments are tested frequently at the Bureau of Standards and each month they are compared with the Potomac Electric Power Co.'s instruments at the company's laboratory.

ILLINOIS

As yet this commission has purchased no equipment for the purpose of gas and electric service tests; we have ordered, however, primary and secondary standards for electrical testing, and a complete heat unit and sulphur and pressure testing equipment for the gas department.

The commission hopes to arrange with the laboratories at the University of Illinois for commercial testing of the standards being used by the different utilities, and in the main expect to have in service within eight months equipment very similar to that now in use by the Wisconsin commission.

MARYLAND

The testing equipment used in standardizing electrical instruments is as follows:

One deflection potentiometer equipped with shunts to measure currents up to 600 amperes and with volt boxes to measure potentials up to 750 volts; three Weston standard cells and two 40-ampere-hour storage cells.

Two millivoltmeters reading directly to 150 millivolts; five shunts in connection with the millivoltmeter to read from 1.5 to 750 amperes. One direct reading voltmeter and one 100 000 ohm resistance.

One polyphase wattmeter with a current-capacity range reading directly from 0 to 10 amperes three-phase and from 0 to 20 amperes single phase and for higher readings, three portable current transformers reading from 25 to 1000 amperes capacity, all with 5-amperes secondaries for instrument connections; this set being provided with the necessary calibrated leads.

One rotating portable watt-hour meter with current capacity from 0 to 40 amperes and voltage of 100 to 200.

Testing currents are taken from a motor-generator set consisting of a variable speed motor 750 to 1800 r. p. m. driving four small generators as follows:

A double commutator direct current potential element giving 120-240 volts, 200 watts capacity. This element is also used for the purpose of exciting its own fields and also the fields of the three other elements.

An alternating current potential element wound to deliver three-phase potential, 120-240 volts at 25 to 60 cycles. The stator is wound in six coils and through the medium of three double-pole double-throw switches these coils may be connected in series and parallel, either star or delta connection.

The frame of the stator is provided with a tangent screw and suitable bearing, so that it may be rotated about the axis of the shaft to give any power factor from zero to unity, either leading or lagging.

The direct-current element gives 80 amperes at 4 volts.

The alternating-current element gives 60 amperes per phase at 5 volts. By the medium of a three-pole double-throw switch and at the appropriate speed, current may be had by throwing the switch to the star connection 25 to 40 cycles; and on the delta connection 40 to 60 cycles. The stator of this element is wound only in three coils.

With this equipment a test current is produced for use in calibrating portable working standards, and also for making tests on different types of service meters. The potential elements deliver only sufficient current; the direct-current element for excitation and that required for potential measurements; the alternating current potential element the current required for potential measurements.

The power required for testing, say, a 50 ampere 110 volt meter is less than 200 watts, including excitation. It was considered best, and has since been demonstrated, that the size of the motor should be disproportionately large. The motor of this set has a full-load rating of 2.8 horsepower at 750 r. p. m., and 6.7 horsepower at 1,800

r. p. m., these speeds giving, respectively, 25 and 60 cycles or any intermediate frequency. This motor-generator set was built by the Holtzer-Cabot Electric Co. on specifications prepared by the engineering department of the commission.

MASSACHUSETTS

The Board of Gas and Electric Light Commissioners of the State of Massachusetts has not established a laboratory of its own, but has entered into an arrangement with the Massachusetts Institute of Technology by which the resources of the standardizing laboratory of its department of electrical engineering are made available for work in connection with tests of electric meters, the tests being made by the professor having charge of that laboratory.

The board owns portable ammeters, voltmeters, wattmeters, and rotating standard watt-hour meters, as well as the load boxes required in testing meters of ordinary size.

This equipment is supplemented by that of the laboratory, which comprises standard cells, certified by the Bureau of Standards, potentiometers for both direct and alternating currents, standard resistances varying in size from 100 ohms to 0.0001 ohm, the latter capable of carrying current up to 1000 amperes. These resistances are certified by the Bureau of Standards.

In addition to the standards, the laboratory equipment includes portable instruments for both direct and alternating current measurements, and a large set of current and potential transformers which allow measurements to be made on alternating current circuits up to 11 000 volts and of any current capacity up to 3000 amperes.

In addition, there are the usual devices for controlling both current and voltage and making all sorts of electrical measurements, such as those of resistance, inductance, capacity, and the intercomparison of direct and alternating current instruments.

In all work the standards used are those of electro-motive force and resistance.

All tests of watt-hour meters are made with the meter installed on the customers' premises, portable indicating instruments and a stop watch are used in all but exceptional cases. Artificial loads are employed whenever practicable, thus giving the tester complete control of the load conditions. For meters of large capacity the customers' load is used, and, as this can not in general be controlled, such tests are made under actual running conditions.

To facilitate these tests on badly fluctuating direct-current loads, a special device has been developed which permits the employment of portable test meters of moderate capacity (40 amperes) for tests on meters up to 2000 amperes capacity. (This is described in the *Electrical World*, June 15, 1912, p. 1309.)

Rotary standards are employed only in those cases when it is impossible to use indicating instruments. Demand indicators of the Wright type are removed from the customers' premises and tested in the laboratory, where conditions may be kept constant. Other demand indicators are tested in place.

MISSOURI

On account of the limited funds at the disposal of the commission, it has been decided for the present to conduct all testing work in connection with electric, gas, and water meters at the laboratory of the State University, Columbia, Mo. The university maintains an electrical standardizing laboratory.

NEW JERSEY

Rutgers College at New Brunswick is the State college, and among the various buildings erected partly at the expense of the State is the Engineering Building. This is arranged for the instruction in mechanical and electrical engineering, and

includes well-equipped measurement and experimental laboratories with a small direct-current generating plant.

A space has been reserved and partitioned off for the use of the commission.

Single-phase alternating current of 60 cycles, at 110-220 volts is available from the street mains, 110 volt direct-current is available from the laboratory plant, and direct current at other voltages, and two and three phase alternating current may be obtained without much delay by the use of the laboratory apparatus.

Each company subject to the commission's jurisdiction is required to install and maintain an ordinary house-type meter of suitable range, located in the meter shop for ready use by the company's meter testers.

This so-called wall standard is for exclusive use in the everyday checking of the rotating standard test watt-hour meter which every company is required to provide and use.

At the present time, the work of the commission's inspectors is confined to the checking of rotating standard watt-hour meters and the wall standards referred to above.

For these purposes there is provided an equipment consisting of: Six rotating standards of various makes and capacities, portable voltmeters and millivoltmeters with a wide range of shunts, instrument transformers, load boxes, etc.

A specially designed test table was installed, having connections for various kinds of current. Centrally located on this table is a Westinghouse precision wattmeter which was calibrated by the Bureau of Standards.

Connections are conveniently arranged for current supply, while above and behind are located banks of lamps and resistance coils, providing both inductive and non-inductive loads.

A potential battery of 266 cells is provided, with permanent connections to the table for various voltages.

For field testing with the rotating standards, two sets of Edison batteries are provided as well as an equipment of lamps and coils, and phantom loads.

A special carrying case for the direct current voltmeter and millivoltmeter with shunts, cords, etc., is provided.

For testing voltage, several portable voltmeters, potential transformers, and recording voltmeters are included.

For field tests of street lamps there is a portable photometer with a specially arranged equipment for measuring candlepower of both gas and electric street-lighting equipment.

The work of checking the switchboard ammeters, measuring current in street-lighting circuits, has been commenced and in the near future the main-output wattmeters in the various plants will be checked.

NEW YORK, FIRST DISTRICT

Since May, 1908, this commission has maintained an electrical laboratory and each year its equipment has been added to and its scope widened. The following investigations are made:

Accuracy tests of watt-hour meters on consumers' premises on complaint of consumer. Special tests of watt-hour meters and devices operated in combination.

Approval tests of watt-hour meters as required by the commission's specifications, rules, and regulations as to watt-hour meters in case No. 1099, dated September 30, 1913.

Approval tests of maximum-demand recorders and indicators.

Checking, certifying, and calibrating portable rotating test meters, voltmeters, ammeters, millivoltmeters, and wattmeters. This work is general and applies to our laboratory as well as to those of lighting companies whom we assist in the maintenance of their laboratory and portable instruments.

We certify to their permanent standards monthly.

Photometric tests of interior lighting, railway coaches, elevated and trolley cars, station platforms, stairway, rooms, and entrance ways. This work is done upon complaint and special investigation or to check certain specification requirements.

Conductivity tests of contact rails and running rails for new subways and elevated roads.

Maintenance and tests of subway electrical pump equipment. (Subways completed but not yet in operation.)

STATIONARY PRIMARY STANDARDS.—Potentiometer, galvanometer, three standard cells, volt box 15, 150, 300, 600 volts.

Precision rheostat, 1 to 6 ohms; precision wattmeter, 5, 10 amperes, 150, 300 volts; precision ammeter, 5, 10 amperes; precision voltmeter, 150, 300, 600 volts; precision current transformer ratios 10:1–40:1–80:1; standard resistances 10, 1.0, 0.1, 0.01, and 0.001 ohms.

PORTABLE PRIMARY STANDARDS.—Precision wattmeter from various makers 2.5 and 5 amperes, 30, 150, 300 volts; 1.5, 3, 20, 40 amperes, 150, 300 volts; 300 amperes 150, 300, 600 volts.

STATIONARY SECONDARY STANDARDS.—Voltmeters 5, 15, 150, 300, 600 volts, millivoltmeters 0.75, 1.5, 15, 30, 75, 150, 300, 750 amperes.

PORTABLE SECONDARY STANDARDS.—Six voltmeters 150, 300 volts; two 750 volts, direct current; four 150, 300 volts alternating current. Six millivoltmeters 1.5, 15, 75, 150, 300 amperes; two 750, 1500, 3000 amperes. One 5, 10 amperes alternating current ammeter. Four standard test meters, 5, 10, 20, 40 amperes, 100, 200 volts alternating current. Two current transformers 20:1, 40:1, 80:1; one current transformer 5:1, 10:1, 20:1. Two millivoltmeters 30 millivolts, direct current. One voltmeter 50 volts alternating current moving and fixed coil connections separate for transformer ratio checking.

OTHER INSTRUMENTS.—One curve drawing voltmeter, 150, 600 volts, 8-day clock, and one curve drawing voltmeter, 150, 300 volts, 24-hour clock. Two curve drawing voltmeters, 90, 150 volts, 6-day clock, one portable photometer, one pantagraph, carbon compression, water, and slide wire rheostats.

LABORATORY SOURCE OF ENERGY.—One hundred and twenty volt direct current circuit from isolated building plant supplies power to drive a three-machine motor-generator set and charge storage batteries. Motor-generator set consists of a $12\frac{1}{2}$ horsepower 120, 240-volt interpole direct current motor directly connected to alternator and low-voltage direct-current generator. The alternator is $7\frac{1}{2}$ K. V. A. and arranged to give two or three phase at the terminals 100 or 200 volts, 60 cycles at 1800 revolutions per minute.

The low-voltage generator is 6 volts 250 amperes, or 3 volts 500 amperes 2-commutator type, and is used to charge four 300-amperehour Edison storage cells. All machines are excited from 120-volt Edison storage battery; 100, 40-amperehour cells. When the alternator is supplying energy, the low-voltage generator is connected to the four 300-amperehour storage cells and the combination floated to produce better regulation in the set.

NEW YORK, SECOND DISTRICT

The commission has not published any printed matter describing this equipment, excepting such reference as has been made thereto in the annual reports. For your information the following description is given:

PRIMARY STANDARDS.—One potentiometer; six Weston standard cells, standard resistances of 0.01, 0.1, and 1.0 ohm, respectively, and one volt multiplier.

SEMIPRIMARY STANDARDS.—One laboratory millivoltmeter and shunts, one laboratory voltmeter, and one zero reading wattdynamometer.

PORTABLE STANDARDS.—Sixteen shielded-type dynamometer wattmeters of various capacities, dynamometer voltmeters, induction ammeters, millivoltmeters, and shunts and stop watches.

In addition there are eight portable series transformers ranging in capacity from 25 to 1600 amperes and three portable shunt transformers for 1100, 2200, and 6600 volts.

TESTING CURRENT SUPPLY.—Direct current is supplied from two storage batteries, one set supplying the potential coils of instruments and meters and the other set supplying the current coils. Single and three-phase currents from 20 to 75 cycles are supplied from two three-phase generators of a variable speed motor-generator set, one generator supplying the potential coils of instruments and meters, and the other supplying the current coils. By shifting the field poles of one generator, any phase relation between the current generated by the two machines is obtainable. A third alternating-current generator furnishes 110 to 140 cycle single-phase current.

The commission has under consideration the purchase of the following additional equipment:

Apparatus for obtaining two-phase currents, precision-current transformers, current and potential transformers for circuits up to 16 500 volts, laboratory wattmeters, and rotating watthour testing standards.⁴³

OHIO

This commission has not as yet made provision for laboratory equipment for the standardizing of electrical measuring instruments. It is very probable that the commission will make arrangements to utilize the very adequate facilities of the electrical engineering department of the Ohio State University.

The commission has taken steps to procure portable testing instruments, such as rotating standards and portable voltmeters and ammeters, and it is the intention to have these checked and calibrated at the laboratory of the Ohio State University.

OREGON

The electrical testing equipment of the Railroad Commission of Oregon includes working standards for tests in the field and secondary standards for the frequent calibration of the working standards and also for any tests requiring unusual accuracy. The secondary standards are checked at intervals by the primary standards at the University of Oregon and the Oregon Agricultural College. The secondary standards were selected for accuracy and portability, the instruments being grouped in convenient carrying cases, so that with proper care they may be taken wherever an especially accurate field test is required.

WORKING STANDARDS.—Portable induction rotating test meter. 110–220 volts; 1 to 100 amperes.

Portable direct-current rotating standard, 110–220 volts; 1 to 100 amperes with multiplier to increase range to include 500 volts.

PORTABLE RECORDING VOLTMETERS FOR SERVICE TESTING. SECONDARY STANDARDS.—Precision electro-dynamometer wattmeter; alternating current or direct current for 5 amperes and 100 volts, with multiplier for 60, 150, 300, and 600 volts.

Precision electro-dynamometer voltmeter; alternating current and direct current for 120 volts with multiplier for 240 and 360 volts.

Precision electro-dynamometer ammeter for 5 amperes.

Precision potential transformer for 3000 volts.

Precision potential transformer for 15 000 volts.

Precision current transformer for working pressure 12 000 volts, ranges 25, 50, and 100 to 5 amperes.

Precision direct-current voltmeter for 3, 150, 300, and 150 volts.

Precision direct-current ammeter with shunts for 1.5 to 150 amperes.

Alternating and direct-current voltmeter for 150 and 300 volts.

Alternating and direct-current wattmeter for 10 amperes and 150 and 300 volts.

⁴³ The inventory recently made shows that there is \$8319 worth of apparatus in the laboratory. (Seventh annual report, 1913, vol. 1, p. 87, New York, second district.)

In addition to the above instruments one of the large operating utilities has furnished a demonstration board for the Portland office of the commission, on which are mounted alternating-current and direct-current watthour meters, a recording voltmeter, various sizes of carbon, and tungsten lamps for comparison, and a suitable switchboard and plugs for testing consumers' heating devices, etc.

The Oregon public utilities act which appears as chapter 279 of the laws of 1911, section 24, gives the commission the power to enter upon the premises of any public utility and to set up and use on such premises any apparatus and appliances and occupy a reasonable space therein.

Taking advantage of this act, we have cooperated with one of the large utilities at their meter-testing department and have been allotted a space for our instruments in the fireproof vaults, under our own lock and key, and have been given space in the meter-test shop where we can make such tests as are needed and desired.

WISCONSIN

The following is quoted from Circular No. 1, The Standards Laboratory of the University of Wisconsin:

"To render more direct service to the public utilities and industries of the State, and because there is at present no conveniently located testing laboratory to which electrical instruments may be submitted for testing, the standards laboratory of the University of Wisconsin has been reorganized. Its staff now standardizes the instruments used by the Railroad Commission of Wisconsin and is prepared to perform similar service for the industries of the State. Electrical instruments and incandescent electric lamps may now be submitted for testing and standardization subject to a set of regulations and schedule of fees discussed later. * * *"

LABORATORY EQUIPMENT.—The equipment of the laboratory may be divided into two general classes, primary standards and secondary standards. The primary standards at present consist of a set of Weston standard cells and a set of Wolff standard resistance units varying from 0.001 ohm to 100 000 ohms. The voltage of the above cells is known accurately to within 0.02 per cent and the standard resistances with the exception of the extreme values have been certified to an accuracy of 0.005 per cent. These standards are maintained in duplicate sets so that one set may be held in reserve for purposes of intercomparison while the other is used in the calibration of the secondary standard instruments. * * * The auxiliary primary standard apparatus includes a Wolff precision potentiometer, a Leeds voltbody and a high sensibility galvanometer.

SECONDARY STANDARD APPARATUS.—At present, the secondary standard ammeters and voltmeters are all of the deflection type and includes for direct-current work a Weston standard direct-current ammeter and a similar voltmeter with various ranges up to 1000 amperes and 750 volts, respectively. The alternating-current standards are of the Siemens-Halske precision type with ranges practically the same as those given above for the direct-current standards.

Power measurements are made with a Westinghouse precision wattmeter of the balance type. With this instrument measurements can be made with both direct and alternating currents over ranges up to 1500 volts and up to 100 amperes. * * *

The photometric equipment at present includes a 300-cm precision photometer bar with all auxiliary apparatus necessary for both standardization work and commercial testing, a 500-cm bar with mirror-selector attachment for the determination of distribution curves of large light-sources, a 72-inch spherical photometer for the measurement of total light flux from large light sources, and a portable Universal Sharp-Millar photometer for both interior and street illumination work. The photometric standards consist of certified carbon and tungsten incandescent lamp standards of various sizes, which have been certified by the Bureau of Standards at Washington.

POWER SUPPLY.—The power supply available for the laboratory includes a 120-volt, 120-amperehour storage battery, a 100-kw 110-volt direct-current Bullock generator, which can also be converted into a low-voltage machine for heavy-current calibrations, a 50 kw 110-volt three-phase Allis-Chalmers alternator, and various small motor generator sets and transformers for meter testing.

RENTAL OF METERS.—The spare test meters of the Railroad Commission will be kept at the laboratory. When a public utility finds it desirable to use an additional meter, either when its own meter is being repaired or when it is desired to use an extra meter in the field, it may be possible to rent these spare meters. * * * It is hoped that arrangements may be made whereby companies who do not maintain a meter-testing equipment or such as may have occasional need of additional test men or equipment, may be able to obtain such services from or through the laboratory upon application.

IV. RULES AND REGULATIONS FOR ELECTRIC SERVICE AS ADOPTED BY STATE COMMISSIONS

Rules and regulations for electric service have been adopted and are in force in the States of Arizona, Connecticut, Illinois, Indiana, Maryland, Missouri, Montana, Nevada, New Hampshire, New Jersey, New York, Oregon, Pennsylvania, Washington, West Virginia, Wisconsin, and the District of Columbia, and are under consideration in a number of others. These rules are of interest to all operating companies, and to public-service commissions having the regulation of electric utilities in view, showing what standards of service are considered adequate and proper in the States mentioned.

The rules are, therefore, collected here to show present commission practice. They have been published by the commissions under the following titles, which are listed alphabetically under States, and not in order of adoption and publication. Rules having to do exclusively with gas service are omitted.

ABSTRACT OF TITLES OF STATE RULES

ARIZONA

Arizona Corporation Commission: Docket No. 158. 1. In the matter of the investigation of the manner of delivery and charge to be made for water, electrical energy and gas. * * * March 28, 1914. 2. *In re* Standards for gas and electric service. Docket 112. Effective May 1, 1915. 3. General Order No. 43, May 1, 1915. Effective June 1, 1915.

CALIFORNIA.

Railroad Commission: Case No. 683. In the matter of the practice of water, gas-electric, and telephone utilities requiring deposits before rendering service. November 5, 1915. [See Appendix 5, p. 253.]

CONNECTICUT

Public Utilities Commission: Order B. Order approving and establishing rules, regulations, and standards for electric service. In effect August 1, 1915. Docket 1447.

DISTRICT OF COLUMBIA

Public Utilities Commission of the District of Columbia: 1. Order No. 139. In the matter of regulation of electric service in the District of Columbia, Public Utilities Commission, No. 1236. Effective February 15, 1915. 2. Order No. 140. 3. Order No. 148.

ILLINOIS

State Public Utility Commission of Illinois: Rules establishing standards of service for gas and electric utilities, effective November 1, 1914.

INDIANA

Public Service Commission of Indiana: *In re* Standards for gas and electric service in the State of Indiana. July, 1913.

MARYLAND

Public Service Commission: Standards, rules, and regulations for electrical corporations in the State of Maryland. Effective February 1, 1916. [See Appendix 3, p. 242.]

MISSOURI

Public Service Commission: Rules regulating gas, electric and water service. General Order No. 20. Effective October 1, 1915.

MONTANA

The Public Service Commission of Montana: Standards for gas and electric service. Order No. 92, In effect June 1, 1914.

NEVADA

Public Service Commission of Nevada: Rules and instructions for gas and electric service in the State of Nevada. Adopted June 3, 1911. Circular No. 1. (Supplement to Circular No. 1, issued September 12, 1911, effective October 15, 1911, substitutes rule 20A for rule 20 and adds rules 25 and 26.)

NEW HAMPSHIRE

Public Service Commission of New Hampshire: Rules prescribing standards for electric service, and providing for the testing of meters and otherwise regulating the service of electric utilities. Adopted May 27, 1914. Effective July 1, 1914.

NEW JERSEY

Board of Public Utility Commissioners: Rules, regulations, and recommendations for electrical supply utilities and for all utilities owning or using poles and wires. Adopted December 9, 1913.

NEW YORK, First District

Public Service Commission, First District:

(a) Order prescribing new specifications, rules and regulations as to watthour meters. Case No. 1099. Adopted September 30, 1913. Effective October 1, 1913.

(b) Rules and regulations relative to the testing of electric meters, and to the reporting of such tests to the Public Service Commission, First District. Case 1154. May 27, 1913.

(c) Regulations for testing watthour meters. Case No. 1524. 3 Public Service Commission Reports, (First District, New York), p. 340, and 1914 Report, vol. 1, p. 632.

NEW YORK, Second District

Public Service Commission, Second District:

(a) Rules and regulations to be observed by companies in testing electric meters. Bulletin No. E1. July 15, 1908.

(b) Resolution of June 23, 1908.

(c) Resolution of January 30, 1908.

(d) In the matter of prohibiting the use of certain types of electric meters. Orders of July 3, 1913, and March 25, 1914.

(e) Case No. 2499. In the matter of requiring all electrical corporations, etc., * * * to stencil and number their poles and structures for carrying overhead lines. March 8, 1912. Report 1912, vol. 1, p. 900.

(f) Case No. 1923. Report 1910, vol. 1, p. 951; Report 1911, vol. 1, p. 821; Report 1912, vol. 1, p. 897.

(g) Order of May 13, 1912.

(h) Case No. 1845. Circular No. 65. Regulations governing the filing of contracts and prescribing the form and governing the filing and publication of rate schedules of gas corporations and electrical corporations and municipalities. December 29, 1914.

OREGON

Railroad Commission of Oregon: Rules, orders, and regulations relating to standards of quality, pressure, voltage, and other service conditions of gas, heat, light, water, and power utilities in the State of Oregon. Effective July 1, 1914.

[On July 1, 1915, the Railroad Commission of Oregon became the Public Service Commission.]

PENNSYLVANIA

The Public Service Commission of the Commonwealth of Pennsylvania: Rules and regulations pertaining to electric utilities. Adopted April 9, 1914. Circular 10A. (Prepared by Prof. H. L. Harris, University of Pittsburgh, and Prof. R. H. Fernald, University of Pennsylvania, 1914.)

WASHINGTON

Public Service Commission of Washington: Rules of the Public Service Commission of Washington for the regulation of gas, electric, and water service. Formal Order No. 493. Adopted May 1, 1912. Effective June 15, 1912.

WEST VIRGINIA

Public Service Commission of West Virginia: Rules and regulations for the government of electric, water, and gas public utilities. Effective August 1, 1915.

WISCONSIN

Railroad Commission of Wisconsin: *In re* Standards for gas and electric service in the State of Wisconsin. No. U-232. Decided August 9, 1913.

In order to show clearly the similarities and differences in the rules so far adopted by State commissions, the rules are here arranged alphabetically under headings. In a number of cases State rules are simply numbered, no name or heading being given. In this Circular an attempt has been made to place each rule under the heading best describing the subject matter of the rule. It is believed that all the rules of each commission are included,⁴⁴ and to learn what each State's rules are it is necessary only to read under each heading the rules for the State in question. If no rule is given, none has been adopted.⁴⁵

⁴⁴ The rules for the acceptance of types of watthour meters of the commissions of New York are not here included. See p. 39 for discussion of this subject.

⁴⁵ In the report of the meter committee of the National Electric Light Association, thirty-seventh convention, technical volume, p. 3, is an excellent chart on Electricity Meter Regulations, U. S. A., 1914. For brief tabular comparison of meter regulations in the various States, this chart is very useful.

ACCIDENTS**PENNSYLVANIA**

No. 9. *Accidents*.—Each utility shall keep a record of and shall furnish to the investigator of accidents for the commission, in accordance with the rules of the commission, reports of any and all accidents happening in or about or in connection with the operation of its property, facilities, or service, wherein any person shall have been killed or injured, or property damaged or destroyed, with a full statement as far as possible of the causes of such accidents, and the precautions, if any, taken as prevention against future accidents of similar character.

WEST VIRGINIA

RULE 33. *Accidents*.—(a) Every utility shall keep a record of and furnish to the commission as soon as possible full reports of every accident happening in, or about, or in connection with the operation of its plants, stations, property, and equipment, whereby any person shall have been killed, or seriously injured, or any property other than the utility's damaged or destroyed, with a full statement of the cause of such accident, and the precautions taken to prevent similar accidents in the future, and shall at once make full report thereof to the commission on blanks furnished by the commission to be paid for by the utility.

(b) It is required that all possible care will be exercised by every utility to reduce the life hazard (1) to which employees are subjected in working in stations and substations and on overhead and underground lines; (2) to which the utility's consumers may be subjected by the introduction of their wires into the residences of the consumers, and to which the general public may be subjected by the presence of overhead wires in the public streets and ways. It is also required that every utility will so conduct its affairs as to cause the least possible danger or loss to other public utilities which make use of the public streets and roads, either overhead or underground.

ALLOWABLE ERRORS OF METERS**ARIZONA**

RULE 13. No electric meter shall be placed in service or allowed to remain in service which has an error of registration in excess of 3 per cent on light load, half load, or full load.

CONNECTICUT

RULE E-14. *Computation of average error*.—(a) For the purpose of pre-installation and periodic tests, there shall be determined, at each of the following loads, the average of the results of two tests not differing by more than 1 per cent and continuing for at least 30 seconds each:

(1) The error at light load (not in excess of 10 per cent of the rated capacity of the meter).

(2) The error at heavy load (approximately 75 per cent but not less than 60 per cent of the rated capacity of the meter, or in case the customer's connected load does not attain the latter value, the full connected load may be considered as heavy load for the purpose of this test).

(3) The average error of the meter shall then be computed by taking the algebraic average of the error at light load and the error at heavy load. [See also p. 130.]

RULE E-15. *Meter accuracy*.—(a) No watthour meter that has an incorrect register constant, gear ratio, or dial train, or which registers "creeps" on no load shall be placed in service or be allowed to remain in service without adjustment and correction.

(b) No watthour meter shall be placed in service which has not been tested for accuracy of registration and adjusted to meet these requirements:

Average error not in excess of 2 per cent.

Error at heavy load not in excess of 2 per cent.

Error at light load not in excess of 4 per cent.

Nothing in this rule shall be construed to prohibit the use of meters now in service where the error at light load may be in excess of 4 per cent slow; nor shall this rule be construed to prevent the use of meters the average error of which is not in excess of 2 per cent when tested in accordance with the methods of test employed by the commission.

(c) Alternating current service watthour meters which are to be used on circuits supplying primarily inductive load shall also be tested before installation at 100 per cent of rated current at 50 per cent lagging power factor and, if necessary, adjusted so that the error will not be in excess of 2 per cent under these conditions.

(d) Whenever a test made by the utility or by the commission on a service watthour meter connected in its permanent position in service shows the average error to be in excess of 2 per cent, the meter shall be adjusted to bring all the errors specified in paragraphs "b" and "c" within the specified limits.

ILLINOIS

RULE 21. *Meters: Method of determining average error.*—The average error of a service watthour meter shall be determined as follows: The error at light load—here defined as approximately 10 per cent of the rated capacity of the meter—shall be determined by taking the average of at least two errors, determined from as many separate tests on the same light load, which errors must agree within one-half per cent. The test runs shall be at least 30 seconds long.

In the same manner the error at heavy load—here defined as a load of approximately 75 per cent of the rated capacity of the meter—shall be determined.

The average error of the meter shall then be determined by taking the average of the error at light load and the error at heavy load, proper account being taken of the sign of these two errors: Provided, that where the consumer's connected load does not equal 75 per cent of the rated capacity of the meter, the full connected load may be considered as heavy load for the purpose of the test.

RULE 22. *Meter accuracy.*—(a) *Creeping.*—No watthour meter which registers on "no load" when the applied voltage is less than 110 per cent of standard service voltage shall be placed in service or allowed to remain in service.

(b) *Inspection and Test before Installation.*—No watthour meter shall be placed in service which is in any way mechanically defective or which has incorrect constants or which has not been tested for accuracy of measurement and adjusted, if necessary, to meet these requirements:

Average error not over 2 per cent.

Error at heavy load not over 1 per cent.

Error at light load not over 4 per cent.

(c) *Test for Correct Lagging.*—Alternating-current service watthour meters which are to be used on circuits supplying inductive load shall also be tested before installation at 100 per cent of rated current at 50 per cent lagging power factor, and, if necessary, adjusted so that the error will not be more than 2 per cent.

(d) *Adjustment after Test.*—Whenever a test made by the utility or by the commission on a service watthour meter connected in its permanent position in place of service, shows that the average error is greater than that specified above, the meter shall be adjusted to bring the average error within the specified limits.

(e) *Allowable Error.*—A service watthour meter having an average error of not more than 4 per cent may be considered as correct and no adjustment of charges shall be entailed by such an error.

INDIANA

RULE 15. No electric meter shall be placed in service or allowed to remain in service which has an error of registration in excess of 4 per cent on light load, half load, or full load.

MISSOURI

RULE 3. The allowance of certain variations from correctness on meters as hereinafter specified does not mean that meters may deliberately be set in error by the amount of the tolerance. This tolerance is specified to allow for the necessary irregularities in meter tests and maintenance conducted on a commercial scale.

RULE 31. Any electric service meter tested on complaint or for any other reason after having been in service may be considered as having been recording within allowable limits of accuracy at any possible load if it is found to register within 4 per cent of correct registration when tested in accordance with the provisions of rule 29. After such test, however, the meter shall be adjusted for accuracy in accordance with the provisions of rule 29 [see p. 126] before being again placed in service.

It is suggested that the average accuracy of a meter in service be defined as follows, and that the condition of the meter as thus determined be used as a basis for adjusting consumer's bills for incorrect registration beyond certain limits where any utility makes such adjustments a part of its commercial practice:

Test an induction meter at approximately 5 per cent of rated capacity of meter, normal load, and 100 per cent of rated capacity of meter.

Test a commutator meter at approximately 10 per cent of rated capacity of meter, normal load, and 100 per cent of rated capacity of meter.

The average of the tests at light, normal, and heavy load here defined as the average accuracy or "condition" of meter shall be obtained by multiplying the result of the test at normal load by 3 and adding the results of the tests at light and heavy load and dividing the total by 5.

The normal load referred to shall be considered as the following percentage of full connected load for the classes of installation set forth, or classes similar thereto:

	Per cent
A. Residence and apartment lighting	25
B. Elevator service	40
C. Factories (individual drive), churches, and offices	45
D. Factories (shaft drive), theaters, clubs, entrances, hallways, and general store lighting	60
E. Saloons, restaurants, pumps, air compressors, ice machines, and moving-picture theaters	70
F. Sign and show window lighting and blowers	100

When a meter is found to be connected to an installation consisting of two or more of the above classes of loads, the normal load shall be obtained by multiplying the connected watt load of each class by the percentage specified above and adding the results.

MONTANA

NO. 11. No electric meter shall be placed in service or allowed to remain in service which has an error of registration in excess of 4 per cent between one-tenth and full load.

NEVADA

RULE 15. No electric meter shall be placed in service nor allowed to remain in service which has an error of registration in excess of 2 per cent on normal operating load or 3 per cent on a load of one-tenth the rated capacity of the meter.

NEW HAMPSHIRE

RULE 2. No electric service meter shall be allowed to remain in service which registers upon no load, has an incorrect gear ratio, register constant, test constant, or dial train, or which has an error in measurement in excess of 4 per cent at either light load, normal load, or heavy load.

NEW JERSEY

No. 18. An electric meter may be considered correct when it does not show, in comparison with standards approved by the commission, an error which is greater than 4 per cent on the light load or heavy load.

Definition.—Light load shall be between 5 and 10 per cent of the rated capacity of the meter for an induction meter and between 10 and 15 per cent of the rated capacity of the meter for a commutator meter. Heavy load shall not be less than 60 per cent of full rated capacity of the meter.

RULE 19. The average accuracy of a meter shall be the average of the accuracy at light load and at heavy load as found above, but in all cases except residences where meter is found more than 4 per cent fast, tests shall be made at light load, at normal load, and full load, and the average of these tests shall be obtained by multiplying the result of the tests of the normal load by 3 and adding the results of the tests at light load and full load, and dividing the total by 5.

Definition.—The normal load shall be considered as the following percentage of full connected load:

	Per cent
(a) Residence and apartment lighting.....	25
(b) Elevator service.....	40
(c) Factories (individual drive), churches, and offices.....	45
(d) Factories (shaft drive), theaters, clubs, entrances, hallways, and general store lighting.....	60
(e) Saloons, restaurants, pumps, air compressors, ice machines, and moving-picture theaters.....	70
(f) Sign and window lighting and blowers.....	100

NEW YORK

First District

CASE NO. 1154.—SEC. 10. All meters shall be adjusted so as to register with an error of not more than 1 per cent at 10 per cent load and at 100 per cent load, and both of these adjustments shall be maintained in this condition as nearly as possible. (New York statute fixes 4 per cent error.)

SEC. 12. All meters, whenever possible, shall be tested at three loads; 10 per cent of the full-rated capacity of the meter, normal load, and 100 per cent of the rated capacity of the meter. The average of these tests, obtained by multiplying the result of the test at normal load by 3, adding the result of the tests at 10 per cent capacity and 100 per cent capacity and dividing the total by 5, shall be deemed the conditions of the meter, and such final average shall be reported to the commission on the form prescribed by it.

SEC. 13. In an installation where it is impossible to obtain a load of 10 per cent of the rated capacity or 100 per cent of the rated capacity of the meter, tests shall be made at the nearest obtainable loads to 10 per cent and 100 per cent of rated capacity of the meter and values given in the ratios as stated above.

SEC. 14. The following classification, in percentage of installation, shall be used in determining normal test load.

Classification of installation to be used in testing meters at normal load

	Per cent
A. Residence and apartment lighting.....	25
B. Elevator service.....	40
C. Factories (individual drive), churches, and offices.....	45
D. Factories (shaft drive), theaters, clubs, entrances, hallways, and general store lighting.....	60
E. Saloons, restaurants, pumps, air compressors, ice machines, and moving-picture theaters.....	70
F. Sign and window lighting and blowers.....	100

When a meter is found to be connected to an installation consisting of two or more of the above classes of loads, the normal load shall be obtained by multiplying the connected watt load of each class by the percentage specified above and adding the results.

SEC. 15. The normal load determination shall include every power, lighting, and heating device found connected, so that the same may be properly operated, by installing fuses, closing a switch or operating a controlling device or any combination of these three methods.

SEC. 16. Three tests shall be made at each load at which a meter is tested, but, should any two fail to agree within 1 per cent, additional tests shall be made until three results are obtained which do not vary from one another more than 1 per cent.

NEW YORK**Second District**

RESOLUTION JUNE 30, 1908.—* * * an electric meter of recording or integrating watthour type shall be held to be an incorrect meter if its error is found to be 4 per cent or more fast on any one of the load points at which tested, from one-tenth rated capacity to normal rated capacity; that tests shall be made under normal electrical operating conditions as to voltage if a direct-current meter, and as to voltage, frequency, and power factor if an alternating-current meter; that the percentage of error of any meter shall be determined by dividing the difference between the reading of the standard meter and the reading of the meter under test by the reading of the standard meter, the error of said meter being determined as a percentage error of the true watts as shown by the standard testing meter; provided that any meter which upon inspection is found to creep shall be deemed an incorrect meter, regardless of its performance between the load points above specified.

OREGON

See "Referee or commission tests—fees", under Oregon [p. 133].

PENNSYLVANIA

NO. 11. *Allowable Error.*—No watthour meter shall be placed in service nor allowed to remain in service, which registers at no load when the applied voltage is less than 110 per cent of standard service voltage, nor which is in any way mechanically defective, nor which has incorrect constants nor an error in measurement in excess of 4 per cent.

NO. 12. *Method of Determining the Error.*—The error of a service watthour meter shall be determined as follows: The error at light load, here defined as not less than 5 per cent nor more than 10 per cent of rated capacity for induction type meters, and not less than 10 per cent nor more than 15 per cent of rated capacity for commutator-type and mercury-type meters, shall be determined by taking the average of at least two errors determined from as many separate readings of the same light load which

errors must agree with each other within one-half per cent of registration accuracy. In the same manner the error at heavy load—here defined as not less than 75 per cent nor more than 100 per cent of rated capacity, shall be determined.

The error of the meter shall then be determined by taking the average of the error at light load and the error at heavy load, proper account being taken of the sign of these two errors: Provided, That where the consumer's connected load does not equal 75 per cent of the rated capacity of the meter, the full connected load may be considered as heavy load for purposes of test.

In all cases where it is not practicable to determine the error by the method outlined above, the utility shall have the option of installing an approved check meter or meters, and determining the error of the service meter by comparing the watthours registered by the check meter with the watthours registered by the service meter in the same time. When this option is exercised, the check meter shall be left in circuit until the hand on the first dial of the service meter shall have made at least two complete revolutions. If a utility desires to use "per cent registration," or "accuracy" in place of "per cent error," the per cent registration shall be determined in the same manner as provided above for determining per cent error.

WASHINGTON

RULE 27. No electric meter shall be placed in service or allowed to remain in service which has an error of registration in excess of 4 per cent on one-tenth load or full load.

WEST VIRGINIA

RULE 11. *Accuracy Requirements for Watthour Meters.*—No watthour meter that has an error in registration of more than 2 per cent, plus or minus, at either light load or heavy load shall be placed in service. Whenever on installation, periodic or any other test, a meter is found to exceed these limits, it must be adjusted so as to register correctly to within 2 per cent, at light load and at heavy load and to be without creep.

Definition of light and heavy load.—Light load shall be approximately 5 per cent of the rated capacity of the meter for alternating-current induction-type meters, and approximately 10 per cent of the rated capacity of the meter for commutator-type meters. Heavy load shall not be less than 60 per cent of the rated capacity of the meter for all types. (See p. 136.)

WISCONSIN

RULE 15. No electricity meter shall be placed in service or allowed to remain in service which has an incorrect register constant, test constant, gear ratio, or dial train, or which has an error in measurement in excess of 4 per cent between one-tenth and full-connected load.

APPLICATION OF RULES—DEFINITIONS

CONNECTICUT

Order B.—After due and legal notice given and public hearing had, as on file and record in the office of the commission will fully appear, and pursuant to the authority vested in this commission, we do hereby approve, adopt, establish, and issue the rules, regulations, and standards hereto attached, marked "Exhibit B," and entitled "Rules, Regulations, and Standards for Electric Companies," and

We do hereby require and direct each and every electric company within the definition of section 1 of chapter 128 of the Public Acts of 1911 to adopt and put into effect said rules, regulations, and standards on and after the 1st day of August, 1915: *Provided, however,* That no provision of said rules, regulations, and standards shall be construed to prevent any such electric company from making a special contract with

any customer involving quality or service conditions at variance with those hereby established, and provided further, that said rules may be modified by the commission, as applicable to any particular company, upon petition and proof that it is impracticable for such company under its financial or operating conditions to comply with certain designated provisions thereof.

Nothing in this order establishing rules, regulations, and standards shall be construed to be within the penal provisions of said chapter 128 of the Public Acts of 1911, unless and until the commission shall issue a further order in the premises, directed to any or all of such electric companies, fixing by mandatory order the initial efficiency of electric lamps furnished by such companies, the voltage at which electricity shall be distributed, or any other specific requirement of said rules, regulations, and standards subject to such an order.

A failure, however, on the part of any such electric company to comply with the rules, regulations, and standards hereby established (or as the same may be hereafter modified as applicable to any particular company) shall be *prima facie* evidence against such company that the operation or service involved is not of the standard required by the Public Utilities Commission of the State of Connecticut.

Definitions.—(a) The word “utility” as used in these rules shall be construed to mean any “electric company” as defined in section 1, chapter 128, Public Acts of 1911.

(b) The word “commission” as used in these rules shall be construed to mean the Public Utilities Commission of the State of Connecticut.

(c) The word “customer” as used in these rules shall be construed to mean any person, company, firm, or corporation supplied by any utility with electrical energy.

DISTRICT OF COLUMBIA

ORDERED.—(1) That, under the authority of section 8 of the District of Columbia appropriation act, approved March 4, 1913, creating the Public Utilities Commission, the following regulations for electric service in the District of Columbia be, and the same are hereby, made and prescribed, and obedience thereto and compliance therewith are hereby required of and enjoined upon all corporations and persons furnishing electric service in the District of Columbia, their officers, agents, and employees.

(2) That, on application to the commission and for sufficient cause shown, such modifications and exemptions may be made with reference to these regulations as the facts in each case shall warrant. Noncompliance with any of these regulations will constitute a violation of the law unless such noncompliance is specifically authorized by an order of the commission.

(3) That the department of this commission which has charge of the supervision of electric service be called the Electrical Inspection Bureau.

(4) That these regulations shall take effect February 15, 1915, and shall continue in force until changed or abrogated by further order of the commission.

ILLINOIS

I. STATUTORY.—The Illinois public utilities law, act of 1913, contains the following provisions:

No. 10. *Definitions.*—The term “service” when used in this act is used in its broadest and most inclusive sense, and includes not only the use or accommodation afforded consumers or patrons, but also any product or commodity furnished by any public utility and the plant, equipment, apparatus, appliances, property, and facilities employed by or in connection with any public utility in performing any service or in furnishing any product or commodity and devoted to the purposes in which such public utility is engaged and to the use and accommodation of the public.

No. 54. *Standards of Service.*—This commission shall have power to ascertain, determine, and fix for each kind of public utility suitable and convenient standard commercial units of service, product, or commodity, which units shall be lawful units for the purposes of this act; to ascertain, determine, and fix adequate and serviceable standards for the measurement of quantity, quality, pressure, initial voltage, or other condition pertaining to the performing of its service or to the furnishing of its product or commodity by any public utility, and to prescribe reasonable regulations for examining, measuring, and testing such service, product, or commodity, and to establish reasonable rules, regulations, specifications, and standards to secure the accuracy of all meters and appliances for examining, measuring, or testing such service, product, or commodity.

II. *AUTHORIZATION OF RULES.*—In accordance with the statutory provisions in No. 54 above, the attached rules establishing standards for gas and electric service have been prepared and are approved by the commission this 25th day of September, 1914, to become effective on November 1, 1914.

III. *APPLICATION OF RULES.*—These rules shall apply to any public utility defined as such by the Illinois public utilities commission law which is now or hereafter may be engaged in the production, sale, or distribution of gas or electricity and which comes under the jurisdiction of the commission.

IV. *SAVING CLAUSE.*—The adoption of these rules shall in no way preclude the commission from altering or amending the same in whole or in part, or from requiring any other or additional service, equipment, facility, or standard, either upon complaint or upon its own motion or upon the application of any utility and, furthermore, these rules shall in no way relieve any utility from any of its duties under the laws of this State.

If any utility has been supplying or is under contract to supply a quality of service of greater value to the consumer than that which these rules require, no reduction in such quality or service shall be made by the utility before a determination by the commission of the proper rate to be charged the consumer for the lower grade of service. Such a rate shall, in general, be based upon the cost of furnishing the grade of service required by these rules.

V. *DEFINITIONS.*—The word "utility" used in these rules shall be construed to mean public utility.

The word "commission" used in these rules shall be construed to mean the State Public Utilities Commission of Illinois.

The word "consumer" used in these rules shall be construed to mean any person, firm, or corporation supplied by any utility with gas or electricity.

MISSOURI

RULE 1. The following rules shall apply to all gas corporations, electric corporations, water corporations, and municipalities, as these terms are defined in the public-service commission law, engaged in the business of furnishing gas or electricity for light, heat, or power, or supplying water for domestic or commercial uses within the State of Missouri.

The word "utility" when used in these rules shall be construed to mean any gas corporation, electricity corporation, water corporation, or municipality engaged in the designated business. The word "commission" when used in these rules shall be construed to mean the Public Service Commission of Missouri.

NEW HAMPSHIRE

RULE 1. In the interpretation of these rules "commission" shall be taken to mean the Public Service Commission; "utility" shall be taken to mean any public utility engaged in supplying electric energy to the public, or supplying current to such utility; "lighting hours" shall be taken to mean the hours between sunset and 10.30

p. m.; "light load" shall be taken to mean any load not less than 4 nor more than 10 per cent of the rated capacity of the meter; "normal load" shall be taken to mean the percentage of the connected load according to the following classification:

	Per cent
Residence and apartment lighting	25
Elevator service	40
Factories (individual drive), churches, and offices	45
Factories (shaft drive), theaters, clubs, entrances, hallways, and general store lighting	60
Saloons, restaurants, pumps, air compressors, ice machines, and moving-picture theaters	70
Sign and window lighting and blowers	100

and "heavy load" any load not less than 60 per cent of the rated capacity of the meter.

In determining the percentage error of a meter under rules 5, 6, and 7, the meter shall be tested at light load, normal load, and heavy load.

The average of these tests, obtained by multiplying the error at normal load by 3, adding (algebraically), the error at light load and heavy load and dividing the total by 5, shall be deemed as the average error of the meter, and such final average shall be used in calculating the amount of the refund should it exceed 4 per cent.

OREGON

RULE 1. Application of Rules: Definitions.—(a) The adoption of these rules and standards shall not preclude the commission from altering or amending the same in whole or in part, or from requiring any other or additional service, equipment, facility, or standards, either upon complaint or upon its own motion, or upon the application of any utility.

(b) The following rules shall apply to any person, firm, or corporation now or hereafter engaged in the business of furnishing gas or electricity for light, heat, or power, or supplying water for domestic or commercial uses within the State of Oregon as a public utility.

(c) The word "utility" used in these rules shall be construed to mean any person, firm, or corporation engaged in such business.

(d) The word "commission" used in these rules shall be construed to mean the Railroad Commission of Oregon.

(e) The word "customer" used in these rules shall be construed to mean any person, company, firm, or corporation supplied by any utility with gas, electricity, or water.

PENNSYLVANIA

Definition.—The term "utility" as used in these rules is here defined as meaning all public-service companies, corporations, and persons, as defined in the public-service company law, engaged in the production, sale, or distribution of electricity within the jurisdiction of the commission.

WASHINGTON

RULE 1. The following rules shall apply to any person, firm, or corporation now or hereafter engaged in the business of furnishing gas or electricity for light, heat or power or supplying water for domestic or commercial uses within the State of Washington. The word "company" used in these rules shall be construed to mean any person, firm or corporation engaged in the business designated. The word "commission" used in these rules shall be construed to mean the Public Service Commission of Washington.

WEST VIRGINIA

RULE 1. Definitions and General Provisions.—(a) In the interpretation of these rules, the word "commission" means the Public Service Commission of West Virginia, and the word "utility" means all persons, association of persons, firms, corporations, municipalities and agencies engaged in the business of generating, furnishing, distributing, and selling electricity, or using electricity for any public purpose. These rules shall not apply to telephone or telegraph utilities.

The word "consumer" shall be taken to mean any person, firm, corporation or municipality supplied by any such utility.

(b) The adoption of these rules and regulations shall not preclude the commission from altering or amending the same in whole or in part, or from requiring any other or additional service, equipment, facility, or standards, either upon request, or upon its own motion, or upon the application of any utility. These rules shall not in any way relieve any utility from any of its duties under the laws of this State.

(c) All existing construction dangerous to life or property should be changed to conform to suitable standards so as to obviate such danger as far as possible, and all reconstruction necessary to conform to the standards herein prescribed should be made as rapidly as practicable. Every utility shall report to the commission from time to time the progress of this work.

COMMISSION INSPECTIONS, TESTS, AND LABORATORY⁴⁶

MISSOURI

RULE 5. It is suggested that those utilities not required to maintain certain testing equipment as hereinafter specified arrange to perform the tests set forth by making use of the testing equipment of some nearby utility required to maintain same. Complete equipment for all tests specified will be maintained at the laboratories of the State University at Columbia, Mo. The engineering laboratories of the State University will be prepared to standardize all testing equipment submitted for a nominal fee.

NEW HAMPSHIRE

RULE 7. The commission will, from time to time, test such meters of each utility as it shall judge expedient. Under the provisions of section 2 of chapter 124 of the Laws of 1913, a fee of 50 cents will be collected from the utility for each meter so tested with a voltage rating not exceeding 250 volts, and a current capacity not exceeding 25 amperes, and for each meter of greater capacity a fee equal to the cost to the commission of testing the same.

RULE 16. The commission will, from time to time, inspect the works and systems of each utility, and the manner in which each such utility conforms to the rules and regulations herein contained. Under the provisions of section 2 of chapter 124 of the Laws of 1913 a fee of not more than \$15 will be collected by the commission from the utility for each such inspection. In any case where the character of service is such as to require extended investigation, a fee sufficient to cover the cost thereof to the commission will be collected.

WASHINGTON

RULE 2. The commission shall designate two or more laboratories where the tests called for by these rules other than those tests to be made by the companies shall be made, and will appoint inspectors under whose direction the tests shall be made at the several laboratories so designated, or elsewhere as near as practicable to the locality where the test is desired.

⁴⁶ See also p. 130, "Referee tests."

COMPLAINTS**CONNECTICUT**

RULE 10. Complaints.—(a) Each utility shall make full and prompt investigation of all complaints made to it at the office or in writing by its customers, either directly or through the commission, and it shall keep a file of all substantial complaints which shall show the name and address of the complainant, and the adjustment or disposal made thereof.

ILLINOIS

RULE 7. Complaints.—Each utility shall make a written acknowledgment to consumers of the receipt of all complaints; shall make a full and prompt investigation of all such complaints, and shall keep a record which shall show the name and address of the complainant, the date and nature of the complaint, and the adjustment or disposal thereof.

MONTANA

No. 19. Each company shall keep a record of complaints, which shall include the name and address of the consumer, the date, the nature of the complaint, and action taken to satisfy.

NEW HAMPSHIRE

RULE 17. Each utility shall keep a record of all complaints in regard to service, which shall include the name and address of the consumer, the date, the nature of the complaint, and the date and method of disposition.

NEW JERSEY

No. 8. Each utility shall keep a record of complaints received at its office in regard to service, which shall include the name and address of the customer, the date, nature of complaint, and the remedy. The record shall be available for inspection at any time within one year by duly accredited representatives of the Public Utility Commission.

OREGON

RULE 10. Complaints.—Each utility shall make a full and prompt investigation of all complaints made to it by its customers either directly or through the commission, and it shall keep a record of all complaints, which shall show the name and address of complainant, the date and character of the complaint, and the adjustment or disposition made thereof. The information contained in such record shall be furnished the commission upon its request.

PENNSYLVANIA

No. 6. *Complaint Records.*—Each utility shall keep a record of all written complaints received from its consumers in regard to service, which record shall show the name and address of the complainant, the date and nature of the complaint, the action taken, and the date of final disposition of the matter. These records shall be kept as specified in rule 10.

WASHINGTON

RULE 12. Each company furnishing gas, electric current, or water shall keep a record of all complaints made to it by its consumers, which record shall include the name and address of the consumer, the date, a statement of the complaint, and a statement of what the company did in reference thereto; and such information shall be furnished to the commission upon request.

WEST VIRGINIA

RULE 29. *Record of Complaints as to Service.*—Every utility shall keep a record of all complaints received at its office in regard to service, including the name and address of the consumer, the date, nature of complaint, and the action taken. This record shall be available for inspection at any time within one year by any representative of the commission.

CREEPING METERS ^{46a}**ARIZONA**

RULE 12. No electric meter which registers upon "no load" shall be placed in service or allowed to remain in service.

ILLINOIS

(See "Allowable errors," under Illinois.)

INDIANA

RULE 14. (Same as Arizona.)

MISSOURI

RULE 30. No electric service watthour meter shall be allowed in service which has incorrect constants or dial train, or which creeps at no load when maximum service voltage under which meter operates is applied, or which is in any way mechanically defective.

MONTANA

No. 10. (Same as Arizona.)

NEVADA

No. 14. (Same as Arizona.)

NEW HAMPSHIRE

(See "Allowable errors" under New Hampshire.)

NEW JERSEY

No. 20. (Same as Arizona.)

NEW YORK**First District**

CASE 1154. SEC. 11. A meter shall be considered to be creeping when on no load the disk rotates at the rate of one revolution in 5 minutes or less. The observation shall be made with all house wires removed from the meter and with no current flowing in the consumer's circuit. All meters in service must be left without creep.

OREGON

RULE 24. Defective Meters.—(a) No electricity meter shall be placed in service or allowed to remain in service which registers upon no load, or which has an incorrect register constant, test constant, gear ratio, or dial train.

PENNSYLVANIA

(See "Allowable errors" under Pennsylvania.)

WASHINGTON

No. 26. (Same as Arizona.)

^{46a} See also p. 75, "Allowable errors."

WEST VIRGINIA

(See "Allowable errors" under West Virginia.)

WISCONSIN

No. 14. (Same as Arizona. All the States' rules here referred to Arizona are the original Wisconsin rule.)

DEPOSITS TO INSURE PAYMENT OF BILLS

CONNECTICUT

RULE 8. *Deposits, Minimum Charges, etc.*—(a) To insure payment of periodic bills, any utility may require from any customer or prospective customer a deposit of an amount not to exceed the estimated bill for a period of 30 days in excess of the billing period. Interest thereon, at the rate of 4 per cent per annum, payable annually or upon the return of the deposit, shall be paid by the utility to each customer making such deposit for the time such deposit was held by the utility and the customer was served, unless such period of time be less than three months.

(b) If the reasonableness of any charge, rule, regulation, or practice of any utility with reference to service connections, minimum charges, or meter rentals is challenged, the commission will, upon formal petition and investigation, prescribe the proper charge, rule, regulation, or practice which shall thereafter be followed.

DISTRICT OF COLUMBIA

ORDER 148. (1) That whenever a deposit is required of a customer by a utility, interest at the rate of 5 per cent be paid thereon during the time that the deposit is retained by the utility.

(2) That this order take effect May 1, 1915, and continue in force until changed or abrogated by further order of the commission.

MISSOURI

RULE 12. Each utility may require, at any time, a cash deposit or a personal guaranty of a responsible person, at its option, from any consumer before metered service is furnished; provided that the amount so required to be deposited or guaranteed shall not exceed an estimated bill covering one billing period plus 30 days from such consumer.

Interest at the rate of 6 per cent per annum, payable annually or upon the return of any deposit covering the time of the deposit, shall be paid by the utility to the consumer upon every cash deposit so required; provided said cash deposit remains for a period of at least six months; provided, further, that the rate of interest of such cash deposit shall be only 3 per cent per annum if the utility keeps such cash deposit in a separate and distinct trust fund and deposited as such in some bank or trust company and not used by the utility in the conduct of its business; and provided, further, that this rule shall not be construed so as to conflict with the charter provisions of any city.

Instead of the annual payment of interest on cash deposits as stipulated above, any other interval between payments agreed to in writing by consumer will be satisfactory to the commission.

If the reasonableness of any rule, regulation, or practice of any utility with reference to cash deposits or personal guaranty is challenged, the commission shall, upon complaint and investigation, prescribe the proper rule, regulation, or practice which shall thereafter be followed.

NEW YORK

Second District

CASE 1923. *Ordered*, That each and every gas corporation and electrical corporation having on hand deposits of consumers pursuant to section 63 of the transportation corporations law, and each and every such corporation which may hereafter exact deposits from consumers pursuant to said provisions of law, be and the same are and shall hereafter be required:

1. To keep a record of each deposit received, such record to be in accordance with the requirements of the uniform system of accounts prescribed by the commission for gas corporations and electrical corporations as set forth in the account No. 357a, entitled "Consumers' deposits" and reading as follows:

"Credit to this account, as such deposits are made, all cash deposited with the corporation by consumers as security for the payment of (gas-electric) bills. Deposits refunded shall be charged to this account and credited to "Cash." Deposits applicable to uncollectible or worthless (gas-electric) bills shall, at the close of the fiscal year (or earlier at the option of the accounting corporation), be credited to the account of the consumer involved and debited to this account."

2. To keep, in addition to the record prescribed in paragraph 1, above, and in such manner as each such corporation may elect, such other and further records as will show with respect to each deposit now on hand or hereafter received (a) the name of the consumer making the deposit, (b) the premises of the consumer at the time the deposit is made and each successive premises occupied by the depositor so long as he remains a consumer or until the deposit with interest be refunded him, (c) the date of the deposit, (d) the amount of the deposit, (e) the interest accrued on the deposit at the end of each calendar year, and (f) a record of each transaction concerning such deposit, and such other information as each such corporation may deem necessary to a complete record of each deposit.

3. To keep, in addition to the records hereinabove prescribed, an index which shall show at all times the name of each and every consumer, alphabetically arranged, from whom a deposit has been exacted, and whose said deposit or a balance thereof is on hand, with appropriate reference on each card to the consumer's ledger account.

4. To allow and pay to every depositor legal interest, to wit, interest at the rate of 6 per cent per annum on the sum deposited for the time his deposit or any balance thereof shall remain with the corporation.

5. To render each depositor, when and as his deposit is applied to unpaid bills, a statement, showing (a) the bill or bills in arrears and unpaid; (b) the amount thereof; (c) the amount of the deposit, together with the accrued interest, applied in payment thereof; and (d) the balance of the bills remaining unpaid, or the balance of the deposit remaining to the depositor's credit, as the case may be.

6. To render such depositor, when and as his deposit may be refunded to him, a statement showing (a) the amount of the deposit; (b) the amount of the accrued interest from the date of the deposit; (c) the interest amounts paid, if any; (d) the amount of the deposit and interest refunded.

7. Each depositor upon ceasing to be a consumer shall have the right to withdraw his deposit and all accrued interest thereon upon surrendering his deposit certificate and payment of all bills for which the deposit is security. Such deposit shall not bear interest from and after the date the depositor ceases to be a consumer. Mere change of residence or of location of service is not to be deemed of itself to be such a cessation.

8. To issue to every consumer from whom, on and after the 1st day of February, 1911, a deposit may be exacted, a certificate of deposit, for which shall be used a good

quality of Scotch linen ledger paper of some distinctive color, and there shall be printed upon the face of said certificate in a conspicuous manner the following:

This receipt is not negotiable or transferable.

Six per cent interest is allowed on this deposit and will be paid upon the surrender of this deposit certificate or a suitable voucher in lieu thereof and the payment of all bills for which this deposit is security.

Preserve this receipt to be surrendered when deposit is returned.

9. To keep on hand, for distribution to its customers, printed circulars, over its corporate or business name, such circulars to be entitled "*Terms and conditions upon which consumers' deposits are exacted, held, and may be withdrawn,*" and to contain under said title (a) the provisions in full of section 63 of the transportation corporations law (ch. 219, laws of 1909), (b) the order herein of this commission, (c) and such other terms and conditions under the heading "Rules of the company" as such corporation may elect to prescribe in pursuance of paragraph 7 hereinabove. And every such corporation shall on or before the 1st day of March, 1911, provide each consumer having a deposit with a copy of said circular. And every such corporation shall hereafter, prior to exacting a deposit, present a copy of said circular to the consumer or applicant for service from whom a deposit is demanded.

10. To provide reasonable ways and means, in such manner as every such corporation may elect, whereby a depositor who in good faith makes application for the return of his deposit and is entitled to the return of same, but who is unable to produce the original certificate of deposit or receipt, may not be deprived of his rights; provided he shall make affidavit to the effect that the original certificate has been lost or has disappeared, and bind himself, his executor or administrators, to reimburse the company for any costs or expense incurred by the company on account of the original certificate being presented for payment; and

It is further ordered: That with respect to those certain requirements hereinabove prescribed, the method of complying with which is stated to be elective with each corporation, the commission herein reserves the right to approve or disapprove of the specific methods employed as occasion may demand such action; and

It is further ordered: That this order shall take effect the 1st day of February, 1911, and shall continue in force until changed or abrogated by this commission.

OREGON

RULE 8. *Deposits.*—(a) Any utility may require from any customer or prospective customer a deposit on account of current bills, (1) in the case of customers whose bills are payable in advance, not to exceed an estimated 30 days' bill; (2) in the case of customers whose bills are not payable in advance, not to exceed the estimated 60 days' bill of such customer. Interest thereon, at the rate of 6 per cent per annum, payable annually or upon the return of the deposit, shall be paid by the utility to each customer making such deposit, for the time such deposit was held by the utility and the customer was served, unless such period of time be less than three months.

(b) No utility may require from any customer or prospective customer a deposit to pay any part of the cost of installation, except under rules and regulations approved by the commission and set out in the published schedules of the utility.

WASHINGTON

No. 9. Each company supplying gas, electric current, or water may require a deposit or advance payment or other security from the consumer before service is supplied, provided that the amount so required shall not exceed the estimated monthly bill from each consumer. Interest at the rate of 8 per cent per annum payable annually (or upon returning of any deposit covering the time of the deposit) shall be paid by every company to its consumers upon every deposit so required, provided said deposit

remains for a period of at least six months, and provided further, that interest shall cease when the consumption of the product used ceases. If the reasonableness of any rule, regulation, or practice of any company with reference to deposits and advance payments is challenged, the commission shall upon investigation, prescribe the proper rule, regulation, or practice which shall thereafter be followed.

WEST VIRGINIA

RULE 32. Deposits.—Any utility may require from any consumer or applicant a minimum cash deposit of \$2.50 or other guaranty of an amount not to exceed the estimated 60-day bill of the consumer. Interest thereon at the rate of 6 per cent per annum, payable upon the return of the deposit, shall be paid by the utility to every consumer making such deposit, for the time such deposit was held by the utility.

DISCONTINUING SERVICE

ARIZONA

RULE No. 22.—Every public-service utility supplying electricity or gas shall use diligent methods in the collection of its accounts with the purpose of largely eliminating the loss of revenue through bad debts, and to reduce the working capital necessary in the operation of the utility. With this in view, any public-service utility may discontinue the service of a consumer who is delinquent in his account for gas or electricity in excess of 20 days. All amounts due the utility for gas service or electric service and a charge not to exceed \$2 per meter for extraordinary expenses may be collected from the consumer by the utility before the service is again rendered.

MISSOURI

RULE 11. No utility shall discontinue the service of any consumer for violation of any rule of such utility except on written notice of at least 48 hours, advising the consumer in what particular such rule has been violated for which service will be discontinued. It is recommended that such notice be served in the following manner for the reasons set forth:

First.—By inclosing in a registered letter addressed to the consumer a copy of the notice to be served; and the return registry receipt of any such registered letter shall be prima facie evidence of the service of any such notice; and the utility shall preserve a copy of said notice to which shall be attached such return registry receipt, which at all times and in any proceeding resulting from or growing out of said notice, or anything complained of, and contained or set out in said notice, shall be prima facie evidence of service of any such notice.

Second.—A delivery of a copy of any such notice to the consumer or by leaving a copy at his usual place of abode with some member of his family over 15 years of age shall be deemed and, for the purposes of these rules, is hereby made sufficient service of any notice required to be served under this rule. Any such notice may be served by any agent, employee, or servant of the utility and the person serving the same shall make return showing the kind of service had, and the return shall be preserved the same as above set out in case of service by registered letter.

This rule may be waived where a by-pass is discovered on a consumer's service meter or in the event of discovery of a dangerous leakage or short circuit on a consumer's premises, or in case of a consumer utilizing the service in such a manner as to make it dangerous for occupants of the premises, thus making the immediate discontinuance of service to the premises imperative. In the event of discontinuance of service for any of these reasons, the consumer should be notified of such discontinuance immediately with a statement concerning reason for discontinuance.

EXTENSION OF LINES

ILLINOIS

RULE 31. Extension of Lines—(a) Free Extensions.—Each utility shall upon written request for service by a prospective consumer or a group of prospective consumers located in the same neighborhood make free of charge a line extension necessary to give service and furnish free service connection, provided that such line extension does not require more than twice as many poles at standard spacing as there are individual applicants.

(b) Extension Above Free Limit.—If the line extension required in order to furnish service at any point within the corporate limits of any city or village, or for any adjacent suburb of a city or village, is greater than the free extension specified above, such an extension shall be made upon the following conditions: The utility may require a deposit of the cost of the extension above the free limit and shall, in such a case, refund an amount equal to the cost of the free main extension for each additional consumer whose service shall be taken off of the entire extension within a period of 10 years from the making of such extension, but at no time shall the rebate made exceed the original deposit. If the extension is of such length and the prospective business which may be developed by it is so meager as to make it doubtful whether the business from the extension would ever pay a fair return on the investment, the facts shall be reported to the commission for investigation and determination as to the reasonableness of such extension.

This rule shall not be construed as prohibiting any utility from making free extensions of lengths greater than above specified, or from providing a method of return of deposits for extensions more favorable to consumers so long as no discrimination is practiced between consumers whose service requirements are similar.

(c) Contract for Service.—Utilities will not be required to make line extensions as described in this rule unless those to be served by such extensions shall contract to use the service for at least one year.

FILE OF SCHEDULE OF RATES, RULES, AND REGULATIONS

MISSOURI

RULE 13. The practice of any utility covering deposits or guaranties of surety, together with interest paid upon cash deposits, must be filed with the commission as a portion of the utility's schedule of rates under the provisions of the commission's general orders covering the filing and publication of rate schedules.

The practice governing service main extensions by any utility must likewise be filed with the commission as a portion of the schedule of rates on file.

Each utility should file with the commission, within 90 days after receipt of this order, a statement, typewritten, properly identified and dated, on 8½ by 11 inch size sheets, describing its practice under these rules covering:

(a) Description of test methods employed and frequency of tests or observations for determining quality, voltage, and pressure of gas, electric, and water service furnished.

(b) Description of meter-testing equipment, including methods employed to ascertain and maintain accuracy of all testing equipment.

(c) Rules covering testing and adjustment of service meters when installed, and periodic tests after installation.

(d) Rules covering adjustment of consumers' bills for incorrect meter registration.

Revisions in any portion of this statement after filing will necessitate the filing of an entire new statement, properly identified and dated, canceling the one on file. Any such change must receive the consent of the commission in writing before becoming effective.

MONTANA

No. 23. A copy of all schedules of rates, as well as all rules and regulations on file with the commission, shall be kept on file in each office of any and all utilities where payments are made by consumers, and such schedules of rates, rules, and regulations shall be open to the inspection of the public.

NEW YORK

Second District

CIRCULAR No. 65.—*Further ordered:* That under and by virtue of the authority conferred upon this commission by the public-service commission's law, every gas corporation, electrical corporation, and municipality subject to the jurisdiction of this commission is hereby directed and required, on and after February 15, 1915, to keep all of its schedules of rates established and filed with this commission in its main or principal operating office, and to keep at each of its branch business offices where contracts for service are made or payment for services is received, copies of all its established schedules of rates which apply within the area served by any such office. That said schedules kept as aforesaid shall be at all times during office hours readily accessible to the public and shall be immediately produced for inspection upon the demand of any person. That such production for inspection shall be accompanied by such assistance on the part of the proper representative of the gas corporation, electrical corporation, or municipality, as the case may be, having such schedules in charge as will enable the person examining such schedules to determine accurately the rate, charge, rules, and regulations applicable to any particular kind of service for which classification is provided in said schedules.

(The regulations governing filing, etc., are here omitted.)

WEST VIRGINIA

RULE 22. *Filing of Rate Schedules, Rules and Regulations.*—Copies of all schedules of rates for service, charges for service connections and extensions of lines, and of all rules and regulations covering the relations of consumer and utility shall be filed by every utility in the office of the commission. All such schedules, rules and regulations, as filed with the commission, shall be on file in the office of the utility, and shall be open to the inspection of the public.

RULE 21. *Posting of Law, Rates, Rules and Regulations of Utility and Commission.*—Every utility shall provide a suitable table or desk in the outside office, near the cashier's window, to which shall be kept securely fastened by a suitable chain the following:

(1) A copy of the rates, forms of contracts, and rules and regulations of the utility applying to the territory served from that office.

(2) A copy of the law of the State governing public-service utilities.

(3) A copy of the rules and regulations adopted by the Public Service Commission governing public-service utilities.

(4) A suitable placard in large type shall be placed above the said desk or table, notifying the public that a copy of the law, and the rules and regulations, and rates of the utility and rules and regulations of the Public Service Commission, are here kept for their information.

FRAUDULENT USE**ARIZONA**

RULE 21. Any utility supplying gas and electricity, who detects the fraudulent use of gas and electricity by a consumer, may discontinue the service, and need not reinstate same until an amount shall be paid to the utility covering the estimated amount of such commodity fraudulently used, and a charge of \$2 to cover extraordinary expenses incidental thereto. In such cases the utility shall estimate the amount of gas or electricity fraudulently used, from previous or subsequent meter readings, or other proper data.

FREQUENCY VARIATIONS**CONNECTICUT**

RULE E-7. Standard Frequency.—(a) Each utility supplying alternating current shall adopt a standard frequency for its system, or for any subdivisions into which the system may be divided, the suitability of which may be determined by the commission, and shall maintain this frequency to within 5 per cent above and 5 per cent below the standard.

ILLINOIS

RULE 28. Standard Frequency.—Each utility supplying alternating current shall adopt a standard frequency, the suitability of which may be determined by the commission, and shall maintain this frequency within 5 per cent, plus or minus, of standard at all times during which service is supplied: Provided, however, that momentary variations of frequency of more than 5 per cent which are clearly due to no lack of proper equipment or reasonable care on the part of the utility, shall not be considered a violation of this rule.

PENNSYLVANIA

RULE 4. Standard Frequency.—Each utility supplying alternating current shall adopt a standard frequency, the suitability of which may be determined by the commission, and shall maintain this frequency within 5 per cent, plus or minus, of standard at all times during which service is supplied: Provided, that momentary variations of frequency of more than 5 per cent, which are clearly due to no lack of proper equipment or reasonable care on the part of the utility, shall not be considered a violation of this rule.

No. 23. Change of Frequency.—If a utility shall change its standard of frequency, it shall give reasonable notice to all its consumers, and shall make tests and shall readjust all watthour meters as soon thereafter as practicable, and shall refund to the consumer all the excess charges which have been collected from him by reason of the change of frequency.

WEST VIRGINIA

RULE 25. Standard Frequency.—Each utility supplying alternating current shall adopt a standard frequency, the suitability of which may be determined by the commission, and shall maintain this frequency to within 5 per cent above and 5 per cent below the standard at all times.

GROUNDING OF SECONDARIES

CONNECTICUT

RULE E-5. *Grounding of Low-Potential Circuits.*—(a) The rules contained in the current edition of the National Electrical Code regarding the grounding of low-potential circuits shall be followed for all new connections. Each utility shall adopt a plan whereby existing ungrounded circuits shall be changed to conform to this rule, and submit the same to the commission for approval not later than October 1, 1915.

(b) Where local conditions make the complete observance of these requirements impracticable, the statement of such conditions shall be made to the commission in writing.

ILLINOIS

RULE 30. *Grounding of Secondaries.*—The rules contained in the current edition of the National Electrical Code regarding the grounding of secondaries shall be observed in all new construction. Each utility shall adopt a plan whereby existing construction shall be changed to conform to the rules as expeditiously as possible.

NEW JERSEY

XIV. The rules contained in the 1913 edition of the National Electrical Code regarding grounding of secondaries are hereby adopted for all new construction. Each utility shall adopt a plan whereby existing services will be changed to conform to the rule, and submit the same to the board for approval by July 1, 1914.

WEST VIRGINIA

RULE 7. *Grounding of Low-Potential Circuits.*—The rules contained in the current edition of the National Electrical Code regarding grounding of low-potential circuits shall be followed for all new construction. Every utility shall adopt a plan whereby existing service shall be changed to conform to this rule, and submit the same to the commission for approval by January 1, 1917.

INFORMATION FOR CUSTOMERS AS TO SERVICE

CONNECTICUT

RULE E-10. *Information Service.*—(a) Each utility shall specifically inform its customers as to the conditions under which efficient and economical service may be secured from its system, and render its customers reasonable assistance in securing incandescent lamps and other appliances best adapted to the service furnished.

INDIANA

RULE 25. Each company supplying electric energy for incandescent illumination shall specifically inform each of its customers as to the conditions under which efficient illuminating service may be secured from its system.

MISSOURI

RULE 10. Utilities shall, upon request, use their best efforts to inform consumers as to the conditions under which efficient service may be secured from their system and render consumers reasonable assistance in securing the various fixtures, motors, lamps, and appliances best adapted to the service furnished.

MONTANA

No. 18. Each utility supplying electric service shall, upon application, specifically inform each of its consumers as to the conditions under which efficient service may be secured from its system and render its consumers reasonable assistance in securing incandescent lamps and other appliances best adapted to the service furnished.

NEVADA

RULE 24. Each company supplying electrical energy for incandescent illumination shall, upon request, specifically inform its consumers as to the conditions under which efficient and economical illuminating service may be secured from its system.

NEW HAMPSHIRE

RULE 13. Each utility supplying electric service shall, upon application, inform any of its consumers as to the conditions under which efficient service may be secured from its system, and render its consumers reasonable assistance in securing incandescent lamps and other appliances best adapted to the service furnished. It shall adopt some method of informing its consumers as to the reading of meters by printing on bills either a description of such method or a notice to the effect that the method will be explained on application to the utility meter reader. Where meters for more than one consumer are installed in proximity to each other, each meter shall be marked or tagged with the name of the consumer whose service is measured thereby.

NEW JERSEY

No. 10. Each utility supplying electrical energy for incandescent illumination shall specifically inform each of its customers, where unusual conditions prevail, as to the conditions under which efficient illuminating service may be secured from its system.

No. 11. Each utility shall furnish to any prospective customer, on request, a statement of the kind or kinds of service available, giving the adopted voltage, nature of current, and, if alternating current, the frequency and number of phases. Where one class of service is available through only a part of the district served this should be stated in connection with any such application. Where service is available only at certain times of day or night full information must be readily available to all prospective customers or their representatives.

Where unusual conditions prevail each utility supplying electrical energy for power shall specifically inform each of its customers as to the conditions under which efficient and satisfactory service may be secured from its system. When, on account of its size and character, the apparatus desired to be connected to the lines of utility is so unusual as to affect the adequacy of the service furnished to other customers, prospective or otherwise, the conditions may require special provision for the load in question. This applies particularly to such connections as grounded signal system, medical apparatus, welding machines, large motors, large-capacity arc lamps, furnaces, moving-picture machines, wireless-telegraph apparatus, etc. In all cases, however, it is understood that the utility is merely a supplier of its commercial standard electrical energy deliverable at the customer's service cut-out under certain conditions as to pressure, continuity, and regularity.

OREGON

RULE 11. *Information to Customers.*—Every utility shall specifically inform its customers as to the conditions under which efficient service may be secured from its system, and render its customers reasonable assistance in securing lamps or other appliances best adapted to the service furnished.

WISCONSIN

RULE 27. Each utility supplying electric service shall specifically inform each of its consumers as to the conditions under which efficient service may be secured from its system and render its consumers reasonable assistance in securing incandescent lamps and other appliances best adapted to the service furnished.

WEST VIRGINIA

RULE 23. *Information as to Kinds of Service.*—(a) Every utility shall on request of any consumer or prospective consumer furnish a statement of the kind or kinds of service available, giving the standard voltage, nature of current, and, if alternating current, the frequency and number of phases. Where one class of service is available through only a part of the district served this should be stated in connection with any such application. Where service is available only at certain times of day or night full information must be readily available to all prospective consumers or their representatives.

(b) Where unusual conditions prevail every utility supplying electricity for power shall specifically inform each of its consumers as to the conditions under which efficient and satisfactory service may be secured from its system. If other service better suited to the needs of the consumers may be secured by the use of more energy or otherwise, consumers should be so informed.

(c) Every utility shall have the option of refusing to furnish polyphase current for motors of less capacity than 5 horsepower.

INSPECTION OF DISTRIBUTION SYSTEM AND APPARATUS

CONNECTICUT

RULE E-4. *Periodic Inspection of Distribution System.*—(a) Each utility shall, semi-annually, during the spring and fall of each year, make a specific, comprehensive inspection of all its overhead plant, lines, devices, and appliances by means of which it conveys or transmits electrical energy.

(b) The person or persons making such inspection shall render a duplicate written and signed report thereof to the utility, describing the location and circumstances and containing explanatory details of each apparently dangerous condition found. A duplicate copy of such report shall be filed at the office of the commission within 10 days after such inspection. The utility shall also file at the office of the commission a statement showing the date and general character of its correction of any such dangerous condition so found and reported within 10 days after such correction, unless such correction is observed by and appears in the report of the inspector.

NEW JERSEY

No. 12. Whenever any transformers, high-tension insulators, or other appliances are removed from the system for any reason they must be inspected before being reinstalled in the same or other location.

PENNSYLVANIA

No. 8. *Defective Apparatus.*—Whenever any equipment or facilities, the failure of which would involve life hazard, are removed from service for any reason they must be thoroughly inspected and tested before being again placed in service, and no equipment, or facilities shall be placed in service or continued in service which have for any reason become dangerous or are liable to cause injury to persons or damage to property.

WEST VIRGINIA

RULE 2. (b) Every utility shall make annual systematic inspection of its plant, equipment, and facilities during the month of May or June, keeping a record of the results of all such inspections, and shall file with the commission annually, not later than the 30th day of June, a statement of the condition of its plant, equipment, and facilities, in such form as the commission may require.

INSPECTION OF LAMPS AND LAMP RENEWALS

INDIANA

RULE 24. *Inspection of Lamps, etc.*—Each company supplying electrical energy for incandescent illumination shall adopt and maintain some method of procedure which will insure periodic inspection of incandescent lamps to which current is supplied and under which the company will render its consumers assistance in securing incandescent lamps best adapted to the operation of the system. Each company shall submit to the Public Service Commission of Indiana the details of such method of procedure as it may adopt.

NEW JERSEY

No. 9. Each utility supplying electrical energy for incandescent illumination shall inspect in a general way the incandescent lamps of each consumer to whom free lamp renewals are supplied at least once in two years, and render its consumers reasonable assistance in securing incandescent lamps best adapted to the service furnished.

WEST VIRGINIA

RULE 20. *Incandescent Lighting.*—(a) Every utility supplying electricity for incandescent lighting shall inspect in a general way the incandescent lamps of every consumer to whom free lamp renewals are supplied at least once every year, and render its consumers reasonable assistance in securing incandescent lamps and other appliances best adapted to the service furnished.

(b) Lamps furnished by utilities to consumers without charge, "free renewals," or at prices less than open market prices, shall be of an efficiency in watts per candle equal to that of the standard tungsten incandescent lamp, when used on the utilities circuits of standard voltage as defined in rule 24 (p. 148), so that the cost of light per candle power hour to consumers will not exceed the cost per candle power hour when incandescent lamps are bought in the open market.

(c) Where unusual conditions prevail, every utility supplying electricity for incandescent lighting shall specifically inform each of its consumers as to the conditions under which efficient lighting service may be secured from its system.

INTERRUPTIONS OF SERVICE ⁴⁷

ARIZONA

RULE 19. Each utility supplying electrical energy shall maintain a record of all interruptions of service upon the entire system or major divisions of its system, and include in such record, time, duration, and cause of each interruption.

⁴⁷ See also p. 141, "Station records."

CONNECTICUT

RULE 9. *Interruptions of Service.*—(a) Each utility shall keep a record of all interruptions of service involving its entire system or major divisions thereof, including therein a statement as to time, duration, and cause of such interruption.

ILLINOIS

RULE 8. *Interruptions of Service.*—Each utility shall make all reasonable efforts to eliminate interruptions of service, and when such interruptions occur shall endeavor to reestablish service with the shortest possible delay. Whenever the service is interrupted for the purpose of working on the distribution system or the station equipment, this shall be done at a time which will cause the least inconvenience to consumers, and those most seriously affected by such interruptions shall, if possible, be notified in advance.

INDIANA

RULE 22. Each company supplying electrical energy shall maintain a record of all interruptions of service upon the entire system or major divisions of its system, and include in such record, time, duration, and cause of each interruption.

MISSOURI

RULE 6. Reasonable efforts shall be made to eliminate interruptions of service, and when such interruptions occur, service should be reestablished within the shortest possible delay. When service is interrupted for the purpose of working on any portion of the system, such interruption should occur at a time which will cause the least inconvenience to the consumer, and those seriously affected by such interruptions should, if possible, be notified in advance.

A record shall be kept of all interruptions of service on the entire system or major divisions thereof, including the time duration and cause of each interruption. These records shall be filed available for inspection by the commission and preserved for a period of at least one year.

MONTANA

RULE 16. (Verbatim as Indiana.)

NEVADA

RULE 22. (Verbatim as Indiana.)

NEW HAMPSHIRE

(See "Station records.")

NEW JERSEY

RULE 7. Each utility furnishing electric service shall keep a record of the time of starting and shutting down power-station equipment and feeders, together with the indications of the several switchboards instruments at frequent intervals and shall maintain a record of all interruptions of service upon the entire system or major divisions of its system, and include in such record time, duration, and cause of each interruption.

OREGON

RULE 9. Each utility shall keep a record of all interruptions of service upon its entire system or major divisions thereof, including therein a statement as to the time duration, and cause of such interruptions. Such record shall be open at all times to public inspection, and the commission may at any time require from the utility a copy thereof.

PENNSYLVANIA

No. 5. *Records of Load and Interruptions.*—Each utility shall keep a record of the time of starting and disconnecting all street-lighting circuits, of the readings of such instruments at each generating station and at such intervals as are necessary to determine the characteristics of the load, and of all interruption to service affecting the busbars, feeders, or distributing mains, which record shall show the time, duration, extent, and the cause, when known, of the interruption. An interruption is here defined, for purposes of record only, as the interval of time during which the voltage falls below 50 per cent of standard voltage. All such records shall be kept as specified in rule 10 (p. 138) for at least two years.

WASHINGTON

RULE 10. Each company supplying gas, electric current, or water shall keep a record of all interruptions of service upon its entire system, or major divisions of its system, and include in such record the time, duration, and cause of such interruptions, and such records shall be open at all times to public inspection and the commission may at any time require from such company a copy of such record.

WISCONSIN

RULE 23. *Interruption of Service.*—Each electric utility shall make all reasonable efforts to eliminate interruptions of service, and when such interruptions occur shall endeavor to reestablish service with the shortest possible delay. Whenever the service is interrupted for the purpose of working on lines or equipment, this shall be done at a time which will cause the least inconvenience to consumers, and those most seriously affected by such interruptions shall, if possible, be notified in advance.

MAINTENANCE AND CONSTRUCTION

CONNECTICUT

RULE E-1. *Maintenance of Plant, Equipment, and Facilities.*—(a) Each utility shall have and maintain its entire plant and system in such condition as will enable it to furnish safe, proper, and adequate service.

RULE E-2. *Distribution System.*—(a) The distribution system (including transmission lines, substations, overhead systems, poles, lines, transformers, etc.; underground system, manholes, conduits, etc.; street-lighting system; service wires and attachments; meters and instruments) must be constructed and maintained in accordance with accepted good practice. The commission will be inclined to quote the specifications and recommendations of the major organizations of electric utilities as accepted good practice.⁴⁸

RULE E-19. *Reconstruction not required.*—(a) The foregoing regulations, with the exception of Rule E-3 entire (referring to pole identification), shall not be construed to require general reconstruction or reequipping in order to conform with the rules for equipment or construction from time to time contained in the National Electrical Code, or in accordance with the other standards now adopted but not in force when such equipment was installed or construction made, but the commission reserves the right to deal with specific cases as the particular conditions may require.

⁴⁸ NOTE. It is contemplated that rules and standards for joint use of poles will later be issued, pending which issue the recommendations heretofore made by the commission in docket No. 638, pertaining to joint use of poles, will remain in full force and effect.

NEW JERSEY

1. Each utility generating, transmitting, distributing, or selling electricity for light, heat, power, or other purposes, shall have and maintain its entire plant and system in such condition as will enable it to furnish safe, proper, and adequate service.
2. The construction of buildings, machinery, and generating plant of the utility must be in accordance with the requirements of the National Electrical Code of the edition of 1913.
3. The distribution system, including:
 - (a) Transmission lines;
 - (b) Substations;
 - (c) Overhead system, poles, lines, transformers, etc.;
 - (d) Underground system, manholes, conduits, etc.;
 - (e) Street lighting system;
 - (f) Service wires and attachments;
 - (g) Meters and instruments.

must be constructed in accordance with good standard practice. It is expected that all possible care will be exercised by each company to reduce the life hazard to which employees, customers, and others may be subjected by the presence of overhead wires in the public streets and ways. It is also expected that each company will so conduct its affairs as to cause the least possible danger or loss to other public utilities which make use of the streets and roads. *Standard practice for electrical construction work is indicated in various specifications, the names of some of which are given below. The specifications referred to are not to be considered part and parcel of the rules and regulations, but are to be considered as indicative of good standard practice.*⁴⁹

1st. *Specifications covering methods of overhead line construction for 2,300-volt distribution and for street lighting circuits, and specifications for material.*

2nd. *Specifications covering methods of overhead line construction for secondary voltages, including pole wiring for street lighting work.*

3rd. *Specifications attached to "Inter-company agreement form and specifications for the joint use of poles by lighting and telephone companies."*

4th. *Specifications for overhead crossings of electric light and power lines.*

Note.—Numbers 1, 2, 3, and 4 are set forth in the four sections of the "Report of Committee on Overhead Line Construction," approved by the National Electric Light Association, May 29 to June 2, 1911, and section 4 as approved by the committee representing the American Institute of Electrical Engineers, American Electric Railway Association, American Railway Engineering Association, the Association of Railway Telegraph Superintendents, and the American Railway Association.

5th. *Report of the Committee on Power Distribution read before the American Electric Railway Association, October 13, 1913.*

6th. *Report of the Committee on Joint Use of Poles read before the American Electric Railway Association, October 13, 1913.*

7th. *National Electrical Code.*

By National Electrical Code is meant the code which is described as follows:

"The National Electrical Code was originally drawn in 1897 as the result of the united efforts of the various insurance, electrical, architectural, and allied interests, which through the National Conference on Standard Electrical Rules, composed of delegates from various national associations, unanimously voted to recommend to their respective associations for approval and adoption; and presented by the National Board of Fire Underwriters with the various amendments and additions which have been made since that time by them."

⁴⁹ Sections here printed in italics are underscored in the New Jersey rules, and are recommendations only.

The National Conference has disbanded, the work of the Underwriters' National Electric Association and of the National Conference having been taken over by the National Fire Protective Association.

The following associations, formerly members of the National Conference, are represented on the Electrical Committee of the National Fire Protective Association:

- American Electric Railway Association.
- American Institute of Electrical Engineers.
- Association Factory Mutual Fire Insurance Cos.
- National Board of Fire Underwriters.
- National Electric Light Association.
- National Electrical Contractors' Association.
- National Electrical Inspectors' Association.

13. A utility may refuse to connect with any customer's wiring when it is not in accordance with the provisions of the National Electrical Code of 1913, or when the certificate of the underwriters or of the local inspection bureau has not been issued, or when the wiring is defective under the rules of the utility.

30. *The utility should have the right of access to customer's premises, and to all property furnished by the utility at all reasonable times, for the purpose of reading meters or inspecting or repairing appliances used in connection with the supply of service, or for the removal of its property at the time service is to be terminated. The customer should obtain, or cause to be obtained, all necessary permits needed by the utility in giving it access to the appliances referred to. The customer should not permit access to the meter and other appliances of the utility except by authorized employees of the utility or properly qualified State or local inspectors. In case of defective service, the customer should not interfere with the apparatus belonging to the utility, but should immediately notify the proper parties to have the defects remedied.*

31. The utility will not be held responsible for resulting inadequacy of service if customers make additions or alterations to the electrical equipment on their premises without first having notified the utility of their intention so to do, and the installation must comply with the rules of the utility furnishing the service.

32. Nothing herein contained shall require any utility to furnish service until the customer shall have conformed to the reasonable rules of the utility, not inconsistent with the foregoing regulations.

33. The foregoing regulations, with the exception of those referring to pole identification, shall not be construed to require reconstruction in accordance with rules for equipment or construction from time to time contained in the Electrical Code or other standards referred to, not in force when such equipment was installed or construction made, but the board reserves the right to deal with specific cases as the particular conditions require.

PENNSYLVANIA

(See *Reports*, Pennsylvania, No. 7, p. 136.)

WEST VIRGINIA

RULE 2. Maintenance of Plant.—(a) Every utility generating, transmitting, distributing or selling electricity for light, heat, power, or other purposes shall have and maintain its entire plant and system in such condition as will enable it to furnish safe, proper, and adequate service.

RULE 3. Plant to be in Accordance with National Electrical Code.—The construction of buildings, machinery, and generating plant of the utility shall be in accordance with the requirements of the current edition of National Electrical Code, as far as feasible.

RULE 4. *Standard Practice.*—The distribution system, including:

- (a) Transmission lines;
- (b) Substations;
- (c) Overhead system poles, lines, transformers, etc.;
- (d) Underground system, manholes, conduits, etc.;
- (e) Street lighting system;
- (f) Service wires and attachments;
- (g) Meters and instruments;

must be constructed and maintained in accordance with good standard practice.

METER INSTALLATION TESTS

ARIZONA

RULE 14. Each electric service meter shall be tested and adjusted for accuracy at the time of its first installation.

CONNECTICUT

RULE 4. *Tests of meters before Installation.*—(a) Every meter installed after August 1, 1915, for measuring electrical energy to any customer, shall be in good order and adjusted by the utility to register within the limits prescribed in Rule E-15 (p. 75) before or within 60 days after being placed in service.

(b) No utility shall, without the consent of the customer, install a prepayment meter adjusted to vend the service at a rate in excess of that charged to customers served through ordinary integrating meters.

RULE E-16. *Installation Tests.*—(a) Each watthour meter shall be checked within 60 days after installation for correct connections, proper mechanical conditions, and suitability of location. In case of meters supplying primarily inductive circuits, a test shall also be made under conditions approximating as nearly as may be to heavy and light loads, as defined in Rules E-14 and E-15 (pp. 75, 76).

DISTRICT OF COLUMBIA

SECTION 5. *Installation Tests and Inspections.*—An installation test shall be made on all commutator-type meters.

An installation test or an installation inspection shall be made on all induction-type meters.

The period between the installation of a meter and the installation test or inspection should be long enough to allow the meter and the conditions around it to reach a fairly permanent state, but not long enough to permit a large registration.

ILLINOIS

RULE 22. (b) (See "Allowable errors," p. 75.)

RULE 23. *Meters; Installation Tests.*—(a) Each watthour meter shall be checked for correct connection, proper mechanical condition, suitability of location, and accuracy of measurement in its permanent position in place of service within 60 days after installation.

(b) Meters operating on inductive circuits shall be tested on the connected load under conditions approximating as nearly as may be to heavy and light loads, as defined in rule 21 (p. 76), and shall be adjusted, if necessary, so that the average error will not be more than 2 per cent.

(c) Meters installed with instrument transformers or shunts must be tested jointly with the transformers or shunts, otherwise the ratio of transformation of the transformers or the calibration of the shunts must be determined at least once every five years.

INDIANA

RULE 16. Each electric service meter shall be tested and adjusted for accuracy at the time of its installation.

MONTANA

NO. 12. Each electric meter shall be tested and adjusted for accuracy within 60 days prior to its installation.

NEVADA

RULE 16. Each electric service meter shall be tested and adjusted for accuracy at the time of its installation.

NEW HAMPSHIRE

RULE 3. Each electric service meter shall be checked for correct connections, mechanical conditions, suitable location, and accuracy of measurement and shall be adjusted to within 1 per cent at light load and heavy load within 60 days after installation. Meters shall be tested under conditions similar to those at which they will be required to operate. Meters installed with instrument transformers or shunts must be tested jointly with the transformers or shunts, otherwise the ratio of transformation of transformers or calibration of the shunts must be determined at least once every five years, and records kept of such tests.

NEW JERSEY

NO. 22. Each electric meter shall be tested and adjusted for accuracy before installation or within 30 days after being set.

OREGON

RULE 21. *Installation Tests.*—Each watthour meter shall be checked for correct connection, mechanical condition, suitable location, and if necessary shall be adjusted to be correct within 1 per cent at approximately three-quarters and one-tenth of the rated capacity of the meter by comparison of the meter in its permanent position in place of service with approved suitable standards at the time of installation or within 30 days thereafter.

PENNSYLVANIA

NO. 14. *Test Previous to Installation.*—Each watthour meter installed after July 1, 1914, shall have been tested for accuracy by the utility within 90 days previous to its installation or shall be so tested within 60 days thereafter. It shall also be inspected by the utility for proper connection, mechanical condition, and suitability of location within 60 days after the installation.

WASHINGTON

RULE 24. Each electric service meter shall be tested and adjusted for accuracy previous to its initial installation.

WEST VIRGINIA

RULE 13. *Installation Tests.*—Every direct current commutator-type watthour meter shall be checked within 30 days after installation for correct connections, mechanical condition, proper and suitable location, absence of creep, and accuracy of adjustment at light and heavy load.

WISCONSIN

No. 16. Each watthour meter shall be checked for correct connections, mechanical conditions, suitable location, and accuracy of measurement at approximately three-quarters and one-tenth connected load by comparing the meter with approved suitable standards in its permanent position in place of service within 30 days after installation. Meters operating at low-power factor shall also be tested at approximately the minimum power factor under which they will be required to operate. Meters installed with instrument transformers or shunts must be tested jointly with the transformers or shunts, otherwise the ratio of transformation of the transformers or calibration of the shunts must be determined at least once every five years.

METER LOCATION

CONNECTICUT

RULE E-II. *Location of Service Meters.*—(a) It is recommended that all meters hereafter installed on customers' premises shall be located in the cellar or first floor, as near as possible to point of entrance of the service, in a clean, dry, safe place not subject to great variations in temperature and on a support as free as possible from vibration. The meter must be accessible for reading and testing.

(b) Meters should not be placed in coal or wood bins or on the partitions forming the same, nor on any unstable partitions or supports. Unless absolutely unavoidable meters should not be installed in attics, sitting-rooms, bath-rooms, bed-rooms, restaurant-kitchens, over doors, over windows, or in any location where the visits of the meter reader or tester will cause annoyance to the customer.

DISTRICT OF COLUMBIA

SECTION 1. *Location of Meters.*—A meter should be so located as to be as near as possible to the point where the service enters the building, to be accessible with a minimum of annoyance to the tenants, to be easily read, to be surrounded by sufficient space to permit the tester to arrange and use his testing apparatus and to make the necessary inspection and adjustments. A meter should be installed on a stable support, in a clean, dry, safe place, free from vibration and not subject to great variation in temperature.

When two or more meters are installed, the distance between centers of commutator type direct current meters shall not be less than 15 inches, and the distance between centers of mercury type direct current or induction type alternating current meters shall not be less than 12 inches.

MARYLAND⁵⁰

Meters.—All meters must be installed in cellars or first floor, unless the particular conditions of the case do not permit it, and except in such cases as the following:

1. Buildings which were wired prior to the issuance of these rules and have meter loops left in other locations.

2. Office buildings and apartment houses; if separate meters are required for each office or apartment, the building should be wired for all meters to be located at a common point in the cellar. Each of these meter locations must be plainly marked in a legible manner to indicate the office or apartment served by it.

3. Buildings in which the various floors are rented separately, but in which there is no common cellar or hallway accessible to all tenants, then the meter must be installed on that particular floor to which the current is supplied.

⁵⁰ Order No. 1378. Public Service Com. of Maryland. This order is applicable only to the Consolidated Gas Electric Light & Power Co. of Baltimore.

4. Under no circumstances will the installation of meters be permitted in bath-rooms, bedrooms, closets, over doors or in inaccessible locations. Meters will also not be permitted on partitions or other supports liable to excessive vibration or in locations subject to excessive moisture or extremes of temperature.

5. Meters must be located as near the point of service entrance as possible and not over 7 feet nor less than 4 feet from the floor.

MISSOURI

RULE 4. Each service meter shall be suited to the particular installation to which it is assigned and chosen with a view of obtaining the best adaptation to local conditions and to the load.

NEW JERSEY

16.^{50a} *All meters hereafter placed in buildings should be located in the cellar or first floor, as near as possible to the point of entrance of the service in a clean, dry, safe place, free from vibration, not subject to great variation in temperature, and the top of the meter board should not be more than 6 feet nor the bottom less than 4 feet above the floor, or above a suitable platform underneath the meter, where it shall be easily accessible for reading and testing.*

Under no circumstances should meters be placed in coal or wood-bins or on the partitions forming the same, nor any flimsy partitions or supports.

In cases where buildings have no cellar, or have very damp cellars or cellars that are not easily accessible, the meter should be installed on the first floor.

Unless absolutely unavoidable meters should not be installed in attics, sitting-rooms, bath-rooms, bed-rooms, restaurant kitchens, over doors, over windows, or any location where the visits of the meter reader or tester will cause annoyance to the customer.

The installation of meters and connections shall be strictly in accordance with the rules of the National Electrical Code of 1913 and the utility furnishing the service.

WEST VIRGINIA

RULE 9. *Location of Meters.*—(a) It is recommended that all meters hereafter installed in consumer's residence shall be located in the cellar, first floor, porch, or other accessible place, as near as possible to the point of entrance of the service in a clean, dry, safe place, as free as possible from vibration and permitting of reading or testing.

(b) The meter should be easily accessible for reading, testing, and making necessary adjustments and repairs. When a number of meters are placed on the same board each meter should be tagged so as to indicate the circuit metered by it.

All direct current commutator-type meters shall be placed at least 15 inches apart.

(c) Meters should not be placed in coal or wood bins or on the partitions forming same, nor on any unstable partitions or supports. Unless absolutely unavoidable, meters should not be installed in attics, sitting rooms, bath rooms, bed rooms, restaurant kitchens, over doors, over windows, or in any locations where the visits of the meter readers or tester will cause annoyance to the consumer.

(d) Districts subject to flood are excepted from this rule as far as it applies to location of meters.

RULE 8. *Methods of Measuring Service.*—After January 1, 1916, no electricity shall be furnished and sold within the State of West Virginia except by metered service.

This does not apply to window, outside decorative lighting, street lighting, transient consumers where the wiring furnished such service is entirely separate from the wiring

^{50a} Where such text is underlined [here in *italics*], the part so underlined should be regarded as the recommendation of this board for the guidance of the utilities to whom said recommendations are applicable, which recommendations should, in the opinion of the board, be observed and followed by such utilities.

inside of buildings, used for general lighting purposes, and limited service as now furnished by the use of excess indicators or similar devices.

For good cause shown, the commission will allow exceptions to this rule in special cases. This rule shall not apply to persons or companies that, as an incident only to their main business, furnish electricity in small quantities to consumers.

METER READINGS FOR CUSTOMERS

MISSOURI

RULE 8. Each utility shall, upon written request of any consumer, cause the meter-reader reading the meter installed upon the premises of such consumer, to leave upon such meter a card or slip showing the date and time such reading was taken, and either the total reading expressed in cubic feet, kilowatt hours, gallons, or other unit of service recorded by the meter read, or showing the position of the hands upon the dial of such meter at the time the reading is taken.

NEVADA

RULE 26. Gas and electric companies shall furnish printed instructions as to the method of reading meters, and post copies of the same in a conspicuous place near the meter. They shall also have their meter readers instruct all customers in the correct method of reading their meters, and shall have their meter readers present to customers at the time meter is read a duplicate record of his reading which shall give the present reading, the previous reading, the consumption for the month just passed, the consumption for the previous month, and the dates of readings.

NEW JERSEY

No. 29. Each utility supplying electrical energy shall adopt some method of informing its customers as to the reading of meters either by printing on bills a description of the method of reading meters, or a notice to the effect that the methods will be readily explained on application. *It is recommended that an exhibition meter be kept on display in each commercial office maintained by the electric utility.*

OREGON

No. 7. (c) On written request by a customer, the utility shall cause the meter reader at the time the customer's meter is read to leave on such meter or with the customer, a card showing the date and time such reading was made, and the reading of the meter expressed either in cubic feet, gallons, kilowatt hours, or other unit of service upon which the charge is made, or the position of the hands on the meter dial.

WASHINGTON

RULE 7. Each company supplying gas, electric current or water within the State, shall upon written request of any consumer, cause the meter reader reading the meter installed upon the premises of such consumer, to leave upon such meter a card showing the date and time such reading was taken and either the total reading expressed in cubic feet, kilowatt hours, gallons, or other unit of service recorded by the meter read, or showing the position of the hands upon the dial of such meter at the time the reading is taken.

WEST VIRGINIA

RULE 18. *Information as to Reading of Meters.*—Every utility supplying metered service shall adopt some method of informing its consumers how watthour meters are read either by printing on bills a description of the method of reading meters, by distributing booklets or folders describing the method, or by notice to the effect that the method will be explained on application.

METER READINGS ON BILLS**ARIZONA**

RULE 23. Each utility shall render bills periodically, designating the reading of meters at the beginning and end of the time for which the bills are rendered and giving the dates at which the readings were taken. The bills shall also show the gross amount charged and net amount after deducting any rebates allowed for prompt payment.

CONNECTICUT

RULE 7. Meter Dials, Form of Bills.—(a) Every meter shall indicate clearly the unit of service for which charge is made to the customer. The dial constant, if other than unity, shall be clearly marked on an exposed part of the meter.

(b) Each utility shall include upon all periodically rendered bills the dates of the beginning and end of the period during which the service was rendered and such other information as will, in conjunction with the published rates of the utility, make possible a convenient recomputation of the charges assessed.

(c) Any utility shall upon request supply to a customer a copy of such utility's rates applicable to the type or types of service furnished such customer. Any utility shall upon request supply to a customer a statement of the past readings of such customer's meter for any period not necessarily in excess of 15 months.

(d) Any utility shall upon the written request of a customer served through a prepayment meter cause the meter reader to leave with such customer at the time of reading the meter a slip showing its reading and the amount of money collected from it.

DISTRICT OF COLUMBIA

SEC. 14. If the dial of a watt-hour meter does not read directly in kilowatt hours, the dial constant shall be clearly indicated on the meter where it can be seen without disturbing any part of the meter.

All bills rendered periodically for service by an electrical corporation shall show on the face thereof the number and kind of units of service supplied, the dates on which the readings were taken, the price per unit of service, and a statement in bold type that the readings of the meter will be furnished on bills upon request. On all bills which are computed on any other basis than a definite charge per unit of service the other factors used in computing the bills shall be clearly stated so that the amount may be readily checked from the information appearing on the bills.

ILLINOIS

RULE 6. Bills rendered periodically to consumers for metered service shall show the readings of the meter at the beginning and end of the period for which the bill is rendered, the number and kind of unit of service supplied, the dates of the meter readings, and the price per unit of service. On all bills which are computed on any other basis than a definite charge per unit of service the other factors used in computing the bill shall be clearly stated so that the amount may be readily computed from the information appearing upon the bill.

MISSOURI

RULE 9. All bills rendered to consumers for metered service furnished shall show the reading of the meter at beginning and end of period for which bill is rendered and shall give dates of readings, number of units of service supplied, and the basis of charge or reference thereto. In general, these bills shall be made out in such a manner as to be readily understood by the consumer and so that the amount of the bill can be checked from the information appearing upon the bill.

This rule may be waived for any consumer by special written consent of such consumer.

MONTANA

RULE 20. Bills rendered periodically by the company shall designate the readings of the meter at the beginning and end of the time for which the bill is rendered and give the dates at which the readings were taken.

NEVADA

RULE 25. Bills shall be rendered monthly by the electric company and shall designate the readings of the meter at the beginning and end of the time for which the bill is rendered, the amount used during the month, and the dates at which readings were taken.

NEW HAMPSHIRE

RULE 12. Bills rendered periodically for metered electric service shall designate the reading of the meter at the beginning and end of the interval for which the bill is rendered and shall give the dates on which the readings were taken and other data necessary to enable the customer conveniently to check the bill.

NEW JERSEY

RULE 27. Meter dials should read directly in kilowatt hours. If not, the dial constant must be clearly indicated where it can be seen without disturbing the case of the meter or the connections. Bills rendered periodically by the utility shall designate the readings of the meter at the beginning and end of the time for which the bill is rendered and give the dates on which the readings were taken. Bills shall also show the gross amount charged and the net amount after deducting the rebate, if any, allowed for prompt payment.

When prepayment meters are in use, the meter reader at the time of reading same shall leave with the customer a slip showing the readings as well as the amount of money collected from the meter.

OREGON

RULE 7. *Meter Readings and Bill Forms.*—(a) Every meter shall indicate clearly the cubic feet, kilowatt hours, gallons, or other units of service for which charge is made to the customer. In cases where the dial reading on a meter must be multiplied by a constant to obtain the units consumed, the proper constant to be applied shall be clearly and plainly marked on the meter.

(b) Bills rendered customers by utilities shall show the readings of the meters at the beginning and end of the period of time for which rendered, the number and kinds of units of service supplied, and the price per unit, and on all bills computed on demand or connected load basis, the amount of connected load, maximum demand, or other factors used in computing the bill, shall be clearly stated, and all bills shall be made out in such a way that the amount may be readily recomputed from the information appearing plainly upon the face of the bill.

WASHINGTON

No. 8. All bills rendered to consumers by any company for gas, electric current, or water shall show the reading of the consumer's meter at the beginning and end of the period of time for which the bill is rendered and shall give the dates at which readings were taken, the number of units of service supplied, and the price per unit; and said bills shall be made out in such a way as to be readily understood by the consumer.

WISCONSIN

RULE 22. Bills rendered periodically for metered electric service shall designate the reading of the meter at the beginning and end of the interval for which the bill is rendered and shall give the dates of the readings of the meter.

WEST VIRGINIA

RULE 19. *Meter Readings on Bills.*—Bills rendered periodically by every utility supplying metered service shall show the readings of the meter at the beginning and end of the time for which bill is rendered, the dates on which the readings were taken, the number of kilowatt hours supplied, and the price per unit. Where prepayment meters are in use, the meter reader at the time of reading same shall, upon request, leave with the consumer a statement of such form as prescribed by the public service commission, showing the readings as well as the amount of money collected from the meter.

METER RENTALS

ARIZONA

RULE No. 20. No rental shall be charged by a utility supplying gas or electric current for any meter installed by it.

NEW JERSEY

No. 15. The utility shall without charge furnish each customer supplied with energy on a measured basis, with an electric meter and such service appliances as are customarily furnished by the utility in order to connect the customer's equipment with its mains.

NOTE.—Any utility now furnishing service through meters owned by customers must arrange to make over the same by January 1, 1915, and thereafter own and maintain all service meters.

OREGON

No. 8c. No rental shall be charged by any utility for any meter installed by it which is used by the utility as the basis for the rendering of bills.

WASHINGTON

No. 11. No rental shall be charged by any company supplying gas, electric current, or water for any meter installed by it.

WEST VIRGINIA

RULE 30. *Service Connections, Charges and Meter Rentals.*—No utility shall make any charge for furnishing any consumer with a watthour meter and such service appliances as are customarily furnished by the utility in order to measure the service furnished to the consumer. In all cases the utility shall pay the cost of connecting its lines with meters. Any appliances furnished at the expense of the utility shall remain its property and may be removed by it at any time after the discontinuance of the service.

METER-TESTING EQUIPMENT

ARIZONA

RULE No. 11. Each utility supplying electrical energy shall provide itself with suitable equipment for the testing of meters, and shall employ such methods as are prescribed by law or by any order of the Arizona Corporation Commission.

CONNECTICUT

RULE 2. *Facilities for Testing.*—(a) All tests made by any utility under these rules shall be performed according to such methods and at such places as may be approved by the commission, and the apparatus, equipment, and rooms used for such tests shall be at all reasonable times available for inspection by or the use of any member of or authorized representative of, the commission.

RULE E-12. Meter Testing Facilities and Equipment.—(a) Each utility furnishing metered electric service shall provide for and have available portable indicating electrical testing instruments and portable watthour meters of suitable range and type for testing its service watthour meters, switchboard instruments, recording voltmeters, and other electrical instruments in use as may be deemed necessary and approved by the commission.

(b) All portable rotating standards shall be compared with reference standards at least once a week for commutator types and once in two weeks for induction types during the time such portable rotating standards are being regularly used. If such check shows any rotating standard to have at any reasonable load an error in excess of 2 per cent, said rotating standard before being used shall be readjusted and certified in some laboratory approved by the commission. Each portable rotating standard shall at all times be accompanied by a certificate giving date when it was last certified, the corrections to be applied at various loads, and signed by the proper authority. These certificates, when superseded, shall be kept on file in the office of the utility.

(c) All portable indicating electrical testing instruments, such as voltmeters, ammeters, and wattmeters, when in regular use for testing purposes, shall be checked against reference standards at least once a week when continually in use, and if found appreciably in error at zero or more than 1 per cent at commonly used scale deflection, shall be adjusted and certified in some laboratory approved by the commission before again being used.

(d) Whenever any utility is maintaining or shall hereafter establish a standardizing laboratory, inspection by the commission will be made of the instruments and methods employed, and if such instruments and methods are approved by the commission after such inspection, certification of portable and reference standards may be made by such laboratory.

DISTRICT OF COLUMBIA

SECTION 3. Apparatus.—Each electrical corporation shall provide and maintain suitable apparatus and facilities for testing the accuracy of meters.

SECTION 4. All working standards shall be tested for accuracy as often as is necessary to insure their maintenance in proper condition for testing meters. If not checked in the laboratory of the electrical corporation, working standards shall be tested in a properly equipped laboratory of recognized standing. Each working standard shall at all times be accompanied by a certificate giving date on which it was last checked and the corrections to be applied to various loads, signed by the proper authority. The certificates, when superseded, shall be kept on file in the office of the electrical corporation.

ILLINOIS

RULE 2. Testing Facilities.—(a) Each utility shall, unless specifically excused by the commission, provide such laboratory, meter-testing shop, and other equipment and facilities as may be necessary to make the tests required by these rules or other orders of the commission. The apparatus and equipment so provided shall be at all times available for the inspection or use of any member or authorized representative of the commission.

(b) Each utility shall make such tests as are prescribed under these rules with such frequency and in such manner and at such places as may be approved by the commission.

RULE 20. Meter Testing Equipment.—(a) *Working Standards.*—Each utility furnishing metered electric service shall provide for and have available suitable and adequate facilities for testing its service watthour meters. These facilities shall be satisfactory to, and approved by, the commission and shall, in general, include a test bench fitted with the necessary apparatus and such working standards as are needed. Such working standards will consist of portable indicating instruments and

watthour meters known as "rotating standards." Working standards shall be calibrated periodically by reference to secondary standards of known accuracy and shall either be maintained accurate to within one-half per cent or the proper correction be applied to their readings.

(b) *Secondary Standards*.—Secondary standards of some approved type shall be owned and maintained by each utility having more than 1000 meters in service. Utilities not required to possess such secondary standards shall have their working standards tested and calibrated in any properly equipped laboratory of recognized standing.

(c) *Check Meters*.—Utilities not required to possess secondary standards shall make the following provision for checking their rotating standards: For each kind (alternating or continuous current) of rotating standard a check meter of suitable type and capacity shall be provided and the rotating standards shall be checked thereby at least once a week while in service. Such check meter may be of the service type and shall be mounted permanently on the test bench. These meters shall be adjusted and sealed by an inspector of the commission and shall be considered the reference standard for the utility. If this check shows the standard to be in error, it shall be calibrated in some laboratory of recognized standing.

(d) *Calibration Cards*.—Each working standard or secondary standard shall be at all times accompanied by a certificate signed by the proper authority giving the date it was last calibrated and the corrections to be applied.

INDIANA

RULE 19. Each company supplying electrical energy shall provide itself with suitable equipment for the testing of meters, and shall employ such methods as are approved by the Public Service Commission.

MISSOURI

RULE 35. Each utility furnishing metered electric service shall maintain suitable working standards of a rugged type for the testing of electric service meters. These working standards must be calibrated frequently to insure their accuracy.

Approved secondary standards shall be owned and maintained by each utility having more than 250 meters in service, for the calibration of the working standards.

All secondary standards, and the working standards of those utilities not required to maintain secondary standards, must be submitted, at sufficiently frequent intervals to insure unquestionable accuracy, to the engineering laboratories of the State University at Columbia, Mo., or the Bureau of Standards at Washington, D. C., or to some testing laboratory of recognized standing, for calibration where the utility does not maintain a testing laboratory having primary standards.

Each standard shall be accompanied by its certificate of calibration dated and signed by the proper authority. These certificates, when superseded, shall be kept on file at the office of the utility, available for inspection.

Meter-testing equipment shall at all reasonable hours be accessible for inspection and use by any authorized representative of the commission.

MONTANA

No. 15. (Same as Indiana.)

NEVADA

RULE 19. (Same as Indiana.)

NEW HAMPSHIRE

RULE 9. Each utility furnishing metered electric service shall have available, in proper working condition, suitable standards for testing its meters, and shall either maintain these standards correct within one-half of 1 per cent or apply the proper corrections to all tests.

NEW JERSEY

NO. 17. (1) All utilities supplying electricity within the State of New Jersey shall provide and properly maintain suitable apparatus and facilities for testing and proving the accuracy of watthour meters.

(2) All portable standards shall be tested and proved as to their accuracy as often as is necessary to insure their maintenance in proper condition for testing of watthour meters. Portable standards, if not tested and calibrated in the laboratory of the electrical utility owning the same, shall be tested and calibrated in any properly equipped laboratory of recognized standing. Each standard shall at all times be accompanied by a certificate giving the date it was last checked. The correction to be applied at various loads and signed by the proper authority.

These certificates when superseded shall be kept on file in the utility's office.

NO. 21. Each utility supplying electricity shall equip itself with a rotating standard test meter of suitable range, and shall fasten permanently on the wall of the meter shop a house or switchboard type meter or meters of suitable capacity, to be used only for checking the rotating standard.

This check should be made at least every week when standard is in service. Utilities supplying direct current or having already other test apparatus, or small utilities having less than 100 meters, may apply to the commission for a modification of this rule. Each wall standard shall be tested at least once a year and certified by the board and furnished with an inspection tag or plate. Rotating standards will not be sealed, but wall standards will be sealed and are to be considered the reference standard for the utility. Where a utility is maintaining a standardizing laboratory, inspection will be made of the instruments in use in this laboratory, and if the instruments and methods are approved, certification of rotating and wall standards may be made by such laboratory.

NEW YORK**First District**

CASE NO. 1524. (1) That all electrical corporations supplying electricity within the first district shall provide and properly maintain suitable apparatus and facilities for testing and proving the accuracy of watthour meters.

(2) That all portable standards shall be tested and proved as to their accuracy as often as is necessary to insure their maintenance in proper condition for testing of watthour meters. Portable standards, if not tested and calibrated in the laboratory of the electrical corporation owning the same, shall be tested and calibrated in any properly equipped laboratory of recognized standing. Each standard shall at all times be accompanied by a certificate giving the date it was last checked, the corrections to be applied at various loads, and signed by the proper authority. These certificates, when superseded, shall be kept on file in the company's office.

OREGON

RULE 2. Testing Facilities.—(a) Each utility shall provide such laboratory, meter testing shop, and other facilities as may be necessary to make the tests required by these rules. All tests made by any utility under these rules shall be carried out in a manner and at such places as may be approved by the commission, and the apparatus and equipment used for these tests shall be at all times available for the inspection or use of any member or authorized representative of the commission.

RULE 20. Meter-testing Equipment.—Every electric utility furnishing metered service shall own suitable working standards for the testing of electricity meters, and either maintain these standards correct within one-half of 1 per cent, or apply the proper correction to all tests. Secondary standards of some approved type shall be owned and maintained by each utility having more than 250 electricity meters in service.

PENNSYLVANIA

No. 15. Each utility shall provide for and have available suitable and adequate facilities for testing its watt-hour meters, in each case to be satisfactory to and approved by the commission. These facilities shall in general include a test bench free from unnecessary incumbrances, one or more portable rotating standard watt-hour meters, a suitable check meter or meters mounted on the test bench, and such other necessary equipment as the commission may require. The check meter shall be the reference standard for the utility, and shall be periodically tested for accuracy and adjusted when necessary by a representative of the commission, and at such place as the commission may direct. Immediately after making final adjustment, the tester shall seal and date-tag the meter, and shall furnish the utility with a correction curve properly dated and signed. The portable rotating standard shall also be tested and adjusted periodically by a representative of the commission, and at such place as the commission may direct. The tester shall furnish the utility with a correction curve properly dated and signed.

During the interval between tests by the commission the portable standard shall be compared with the check meter at least once each week (for commutating types) and at least once every two weeks for induction types during the time the portable meter is in service, and the calibration thus obtained shall be used in determining the error of the service meters. A complete record of these check tests shall be kept for at least two years, as specified in rule 10 (p. 138). This record shall show the condition and accuracy of the rotating standard "as found" and "as left," all in such form and such detail as to permit of convenient checking of the method and results.

All correction curves furnished by the commission shall be kept with the meter until superseded. After January 1, 1915, tests made with uncertified facilities will not be deemed authoritative.

WASHINGTON

RULE 23. Each company supplying electric current shall, when required by the commission, provide itself with suitable equipment for the testing of meters, and shall employ such methods of testing as are approved by the commission.

WEST VIRGINIA

RULE 10. *Meter Testing Facilities and Equipment.*—(a) *Facilities and Equipment.*—Every utility furnishing metered electric service shall, unless specifically excused by the commission, provide for and have available such laboratory, meter-testing shop, standard meters and instruments, and other equipment and facilities as may be necessary to make the tests required by these rules or other orders of the commission. Such equipment and facilities shall be satisfactory to and approved by the commission, and shall be available at all reasonable times for the inspection and use of any authorized representative of the commission.

(b) *Testing Standards.*—1. Each utility furnishing metered electric service shall provide and have available portable indicating electrical testing instruments and portable watt-hour meters of suitable range and type for testing service watt-hour meters, switchboard instruments, recording voltmeters, and other electrical instruments in use, as may be deemed necessary and approved by the commission.

2. For testing the accuracy of portable watt-hour meters, commonly called "rotating standards," and other portable instruments used for testing consumers' service meters, every utility not specifically excused by the commission as provided in section (a) of this rule, shall provide for and have available as reference or check standards, suitable indicating electrical instruments, wattmeters, watt-hour meters, or any or all of them, hereafter called reference standards. Such standards may be of the service type of watt-hour meters, but if so, such watt-hour meters shall be permanently mounted in

the laboratory or meter shop of the utility, and shall be used for no other purpose than for checking rotating standards. All reference standards will be tested, adjusted, and sealed by the commission at least once a year.

3. All portable watthour meters (rotating standards) shall be compared with the reference standards at least once a week for commutator types and once in two weeks for induction types during the time such portable testing standards are being regularly used. If after five readings all of which check within 1 per cent, such check shows any portable watthour meter (rotating standard) to be in error more than one-half per cent, plus or minus, at light load or heavy load, as defined in rule 11, and more than 1 per cent, plus or minus, at any intermediate load, the meter shall be tested, adjusted, and certified either by the commission or by the meterman of the utility in the laboratory of the utility if approved by the commission, or in some other approved laboratory, before being again used. Every portable watthour meter (rotating standard) shall at all times be accompanied by a certificate giving the date when it was last certified and adjusted, the corrections to be applied at various loads, and signed by the proper authority. These certificates when superseded shall be kept on file in the office of the utility.

4. All portable indicating electrical-testing instruments, such as voltmeters, ammeters, and wattmeters, when in regular use for testing purposes, shall be checked against reference standards at least once a week when continuing in use.

(c) *Standardizing Laboratory.*—Whenever any utility is maintaining or shall hereafter establish a standardizing laboratory, inspection by the commission will be made of the instruments in use, and if instruments and methods are approved by the commission after such inspection, certification of portable reference standards may be made by such laboratory.

WISCONSIN

RULE 19. Each utility furnishing metered electric service shall own suitable working standards for the testing of electricity meters, and either maintain these standards correct within one-half of 1 per cent or apply the proper correction to all tests. Secondary standards of some approved type shall be owned and maintained by each utility having more than 250 electricity meters in service.

METER TESTING METHODS AND PLACE

CONNECTICUT

RULE E-13. *Place and Method of Testing.*—(a) All tests of meters provided for in rules 5, E-15, E-16, and E-17 shall be made in the place of permanent location on the customers' premises with approved testing apparatus and under local conditions, unless otherwise stated in any rule. (See pp. 75, 102, 122, 130.)

(b) Meters installed with instrument transformers or shunts may be tested independently of such transformers or shunts, provided the utility applies the corrections indicated by a certificate from the manufacturer exhibiting the characteristics of the type of transformer or shunt in question and guaranteeing the limits of deviation of individual transformers or shunts from the average characteristics of the type; otherwise the meters and transformers or shunts shall be verified as a measuring unit.

DISTRICT OF COLUMBIA

SECTION 2. *Testing Rules.*—All tests made pursuant to these regulations shall be made in compliance with the following rules:

(A) All instruments used as standard instruments in testing meters shall be equipped with scales properly proportioned to the loads measured.

(B) Tests shall be made with the meter in its permanent position on the consumer's premises, and as nearly as possible under operating conditions as regards voltage, frequency, temperature, stray fields, vibration, etc.

(C) When practicable, all meters shall be tested at the following loads: Light load (10 per cent of rated capacity of meter), full load (60 per cent to 100 per cent of rated capacity of meter). On request tests and on referee tests, however, the meter shall also be tested at normal load. In the case of an installation on which it is not practicable to obtain these loads, tests shall be made at loads as near as possible to these. In a case in which the full connected installation^{50b} amounts to less than the rated capacity of the meter, the full connected installation may be taken as the full load of the meter. In determining the normal load the following percentages of the several classes of the full connected installation shall be used:

	Per cent
(a) Residence and apartment lighting.....	25
(b) Elevator service.....	40
(c) Factory lighting, individual drives, churches, offices, stables, hotels.....	45
(d) Factory shaft drives, theaters, clubs, hallways, entrances and general store lighting.....	60
(e) Saloons, restaurants, pumps, air compressors and ice machines.....	70
(f) Sign and window lighting, blowers, moving picture machines.....	100

When a meter is found to be connected to an installation consisting of several of the above classes of loads, the normal load shall be obtained by multiplying the connected watt load of each class by the percentage specified above and adding the results.

(D) Two tests shall be made at each load at which the meter is tested, but should these two tests fail to agree within 0.8 per cent additional tests shall be made until two results are obtained which do agree within 0.8 per cent. On all tests each reading shall cover a period of at least 30 seconds.

(E) Where potential transformers are used in connection with a meter and the line voltage does not exceed 600 volts, the meter shall be tested from the line side of such apparatus. Where current transformers are used in connection with a meter and the line voltage does not exceed 600 volts and the current capacity of the transformer does not exceed 150 amperes, the meter shall be tested from the line side of such apparatus.

Where potential or current transformers are used in connection with a meter and the line voltage exceeds 600 volts or the capacity of the current transformer exceeds 150 amperes, the meter may be tested as a self-contained meter and the ratio certificates of the transformers may be used in calculating the true line watts, provided that, in the case of request and referee tests, said certificates are dated within the year preceding the date of test or the meter and, in the case of all other tests, said certificates are dated within the five years preceding the date of test of the meter.

(F) Where shunts are used in connection with a meter and the current capacity of the shunts does not exceed 600 amperes, the meter shall be tested from the line side of such apparatus. At each test, the voltage drop through the shunt leads, the meter, and their connections should be measured in order to determine whether it has changed since previous tests.

When the current capacity of the shunts exceeds 600 amperes, the meter may be tested as a self-contained meter, and the calibration certificates of the shunts may be used in calculating the true line watts, provided that, in the case of request and referee tests, said certificates are dated within the year preceding the date of test of the meter and, in the case of all other tests, said certificates are dated within the five years preceding the date of test of the meter.

(G) After test, a meter shall be adjusted by the electrical corporation so as to register with an error of not more than 1 per cent at light and full loads when compared with a working standard and so as to be without creep.

^{50b} The full connected installation includes all electrical apparatus found connected and capable of being put in practical operation by the closing of a switch or switches, the installing of fuses, or the operation of controlling devices.

MISSOURI

RULE 29. Each electric service watthour meter placed in service shall be tested and adjusted for accuracy before installation or within 30 days thereafter. It is recommended, however, that this installation test be made after the meter has been set in its permanent location and at the same time it can be checked for suitable location, mechanical condition, and correct connection.

Tests and adjustment for accuracy shall be made at from 5 to 10 per cent, 50 per cent, and 100 per cent of rated capacity of meter. Where normal load under which meter operates will fall between 60 per cent and 100 per cent of rated capacity of meter, an equivalent test load may be substituted in place of the 50 per cent and 100 per cent rated capacity test loads.

Tests for accuracy at each load shall be made with suitable working standards by taking the average of at least two test runs of at least 30 seconds each which agree within 1 per cent.

Any meter operating on inductive load should be tested under the approximate power factor conditions at which the meter will normally be required to operate.

Each meter when tested shall be adjusted as accurately as practical for correct registration at the test loads specified. Where necessary to adjust the meter fast at light or heavy load, for correct registration at normal load, or to correct for inductive load such fast adjustment should not exceed 2 per cent above correct registration.

Commutator type meters should, when feasible, be allowed to remain in actual service at least five days before being tested.

NEW JERSEY

No. 23. Each meter after being tested as found shall be adjusted to record within 2 per cent of correct at heavy load and not more than 2 per cent fast nor 4 per cent slow at light load. This periodic test is to be made by comparing the meter while connected in its place of service with an approved standard at light load and heavy load. Meters removed from service are to be tested and adjusted in the meter room before being put in service again.

NEW YORK**First District**

CASE 1154. SEC. 4. All tests shall be made with the meter in its permanent position on the consumer's premises and under actual operating conditions as regards voltage, frequency, temperature, stray fields, and vibration.

SEC. 5. Where current and potential transformers are used in connection with a meter, the meter shall be tested from the line side of such apparatus, when the voltage does not exceed 600 volts.

SEC. 6. Where current transformers are used in connection with a meter, the meter shall be tested from the line side of such apparatus when the voltage does not exceed 600 volts and the current capacity of the transformer does not exceed 150 amperes.

SEC. 7. Where shunts are used in connection with a meter, the meter shall be tested from the line side of such apparatus, but in the case of very large meters, a calibrated shunt may be installed for the purpose of testing, provided there is on file a calibration certificate dated within the period stated in section No. 3 for periodic complaint, and office tests.

SEC. 8. In periodic and office tests where the line voltage exceeds 600 volts, the meter may be tested as a self-contained meter, and the ratio certificates of the transformers may be used in calculating the true line volts, provided said certificates are dated within the five years preceding the time the meter is tested.

In complaint tests, the commission will accept the ratio certificates of the transformers, provided they are dated within the year preceding the time the meter is tested.

SEC. 9. All indicating instruments used as standard instruments in testing meters shall be equipped with scales properly proportioned to the loads measured.

NEW YORK

Second District

BULLETIN NO. E 1.—I. 1. All tests of consumers' meters shall be made with apparatus which has been approved and stamped or marked by the commission.

2. The percentage registration of a meter at any point shall be determined by dividing the observed meter watts by the standard watts and expressing the result as a percentage of the standard watts.

3. Meters shall be tested under actual operating conditions as regards voltage, frequency, power factor, temperature, stray fields, and vibration as nearly as possible.

4. The light load test shall be made at a point approximately one-tenth the full-rated capacity of the meter; provided that companies now testing their meters at one-twentieth rated capacity for light load point may continue that practice at their option in lieu of the test at one-tenth rated capacity, indicating the same upon report blank.

5. The test at normal load should be made whenever the normal load of the consumer can be approximately determined.

6. The full load test shall be made at approximately the full rated capacity of the meter in all cases except when full connected load of the installation is less than the full rated capacity of the meter, in which case tests shall be made at the full connected load.

7. In addition to the tests at light, normal, and full load, provision is made on the blanks for reporting tests at other load points should such additional tests be made.

8. Meters shall be tested at the point of installation whenever possible, preferably using the connected load. The place of test of each meter shall be specified on the report blank as "plant," "premises," or elsewhere.

OREGON

RULE 4. *Meter Testing.*—(a) Every meter hereafter installed for measuring gas, electric current, heat, or water to any customer shall be tested and if necessary repaired and adjusted by the utility installing it before being placed in use, or in the case of electricity meters, within 30 days thereafter, as provided by rule 21; and every meter tested (except water meters installed underground) shall have firmly attached thereto a tag or label, or be stenciled, giving the date of test, which tag, label, or stenciled mark shall not be defaced or removed until a subsequent test shall have been made.

PENNSYLVANIA

No. 19. *Power Factor Adjustment.*—All alternating current watthour meters which are provided with a power factor adjustment should be tested and adjusted for correct registration within 2 per cent plus or minus, at 100 per cent power factor and within 4 per cent at zero or 50 per cent power factor lagging before installation. All alternating current watthour meters in service which have not been so tested and adjusted before installation, and which are connected to circuit supplying other than non-inductive load, shall be tested for accuracy at 100 per cent power factor and at zero or 50 per cent lagging power factor. In all cases where it is not practicable to determine the error of the meter at these power factors, the utility shall have the option of installing an approved check meter, and determining the error as provided in the last paragraph of rule 12.

No. 20. *Place of Making Tests.*—All tests provided for in rules 14, 16, and 18, and except those made previous to installation as provided for in rule 14, shall be made in the place of permanent location on the consumer's premises, with approved equipment and under local conditions.

No. 21. *Watthour Meter Tests Without Accessories.*—In all cases where a watthour meter is connected to the line through shunts, multipliers, or instrument transformers, the test may be made on the meter as a self-contained unit and the ratio of the accessories used to determine the error of the meter, provided that the certificates of the accessories bear a date within five years and are satisfactory to the commission.

No. 22. *Adjustment After Test.*—All service watthour meters shall be adjusted after test that the error as defined in rule 12 shall not exceed 2 per cent. Neither shall the error at light load exceed 4 per cent nor the error at heavy load exceed 2 per cent.

WASHINGTON

No. 3. Every meter for measuring gas, electric current, or water which has been tested for accuracy by the company furnishing the substance measured, or by an inspector appointed by the commission, shall have firmly attached thereto a tag or label giving the number, size (or capacity) of the meter, the date and result of such test and by whom made. No such card or label shall be defaced or removed until a subsequent test shall be made and a later test record attached. Each of such tags or labels shall have printed thereon the substance of this provision. This rule shall not apply to water meters when set outside of a building underground and in such a position as to make them liable to become submerged. Whenever any test has been made at the request of a consumer, the latter shall be notified in writing within 10 days thereafter by the company, such written notification to contain all information hereinbefore mentioned.

WEST VIRGINIA

RULE 12. *Place and Methods of Testing.*—(a) Every watthour meter, before installation on any consumer's premises, shall be tested for accuracy of registration by a competent meterman, employed by the public service corporation, whose selection has been approved by the commission, and who has taken the oath of office required of all employees of the commission.

(b) After all necessary repairs, adjustments, and final tests have been made so that the meter registers accurately to within 2 per cent as specified in rule 11, the meter shall be sealed and tagged with seals and date tags furnished by the Public Service Commission.

(c) All tests on watthour meters in service provided for in these rules shall be made in the place of permanent location on the consumer's premises with approved testing apparatus and under local conditions, unless otherwise stated in any rule or allowed by special order of the commission.

(d) The results of all tests and adjustments and data sufficient to allow checking of test calculations shall be recorded by the meterman in duplicate on blanks furnished by the Public Service Commission, and the original test record so obtained shall be filed with the commission within 30 days after making the test. All seals, date tags, and meter-test blanks used shall be charged to and paid for by the utility at their actual cost and carriage. Every utility shall provide and use such copper or galvanized sealing wire as the commission may prescribe.

(e) Meters installed with instrument transformers or shunts shall be tested jointly with such transformers or shunts, otherwise the ratio of the transformation of the transformers and the resistance of the shunts must have previously been determined within five years and be on file at the office of the utility. Such tests must have been made by a laboratory of recognized standing, or by the utility, using apparatus and methods approved by the commission.

METER TEST RECORDS

ARIZONA

RULE 16. A complete record shall be kept of all tests made of electric meters.

CONNECTICUT

RULE 3. *Record of Tests, History of Meters.*—(a) A complete record of each test of quality, service conditions, or meter accuracy as made under these rules shall be kept by each utility accessible to the commission, or its authorized representatives.

(b) Each record of tests of quality or of service conditions so kept shall contain complete information concerning the test including such items as the commission may from time to time require.

(c) In the case of any service-meter test the original records shall be preserved indicating the information necessary for identifying the meter, the reading of the meter before being disturbed, the computed accuracy of registration both as found and as left, together with the data taken at the time of the test in sufficiently complete form to permit the convenient checking of the methods employed and of the computations leading to the result.

(d) Records shall be kept, systematically arranged, indicating the approximate date of purchase of each meter, its size or capacity rating, its various places of installation, the date of each repair, adjustment, or test, the reason for making such test, and the general result of each test.

(e) All the above mentioned records shall be preserved for at least three years, excepting service-meter records under rule 3-d, which shall be preserved until the meter is destroyed or permanently removed from service.

ILLINOIS

RULE 5. *Records of Tests and of Meters*—(a) *Service Test Record.*—A complete record of the quality and condition of service shall be kept by each utility. The record so kept shall contain complete information concerning each test, including the date and hour when and at the place where the test was made, the name of the inspector conducting the test, the result of the test and such other information as may be required by these rules, or as the commission may from time to time direct, or as the utility making the test may deem desirable.

(b) *Meter Test Record.*—Whenever any service meter is tested, the original test record shall be preserved containing the information necessary for identifying the meter, the reason for making the test, the reading of the meter upon removal from service, and the result of the test, together with all data taken at the time of the test in sufficiently complete form to permit the convenient checking of the methods employed and the calculations.

(c) A record shall also be kept, numerically arranged, giving for each meter owned or used by any utility, the date of purchase, its identification, and the repairs and tests to which it has been subjected, with dates and general results of all tests.

(d) *Tabulation of Meter Tests.*—Monthly and annual tabulations of the results of all meter tests shall be made, arranged according to types of meters and intervals of test.

INDIANA

RULE 18. A complete record shall be kept of all tests made on electric meters.

MISSOURI

RULE 2. A record shall be kept, alphabetically arranged, of the names and addresses of all consumers furnished with metered service, with the identification number of meter or meters in use by each such consumer.

A record shall be kept, numerically arranged, in accordance with the utility's system of numbering its meters, indicating for each service meter owned or used a proper description, date of purchase (the approximate time of purchase if the exact date is not known), record of the use, repairs, adjustments and tests to which the meter has been subjected, and its present location.

When a service meter is tested the original test record shall be preserved for a period of at least two years. This record shall include the information necessary for identifying the meter, date and place of test, name of person conducting the test, reason for making test, method of test, reading before being disturbed, statement regarding creepage if an electric meter, and the result of the test, together with all data taken at the time of the test so as to permit of the convenient checking of the methods employed and calculations in connection therewith.

NOTE.—Systems of meter and test records already in use will meet with the approval of the commission provided they conform substantially with the foregoing. Application shall be made to the commission for such approval.

MONTANA

RULE 14. (Same as Indiana.)

NEVADA

RULE 18. (Same as Indiana.)

NEW HAMPSHIRE

RULE 10. Whenever an electric-service meter is tested, the original test record shall be kept indicating the information necessary for identifying the meter, the reasons for making the test, the reading of the meter before being disturbed, a statement regarding creepage, and the results of the test, together with all data taken. This record must be sufficiently complete to permit the convenient checking of the methods and the calculations. Each utility shall maintain a meter record, numerically arranged, indicating approximately when the meter was purchased, its identification, its various places of installment, with dates of installation and removal, and the dates and general results of all tests.

NEW JERSEY

No. 17. (5) A complete record shall be kept of all complaint tests, office and periodic tests of watthour meters installed on consumers' premises. Such record shall include:

Owning utility's number.

Manufacturer's name and number.

Type, rated volts, amperes, and wire.

Date of each installation, removal, and test.

The average of the readings at full load, at light load, and at normal load as found at each and every test.

A record of tests of each meter shall be continuous for a period of not less than five years, and in any event of sufficient length to cover three consecutive periodic tests.

(See also "Reports and records," New Jersey, rule 24, p. 137.)

NEW YORK

First District

CASE No. 1524. (5) That a complete record shall be kept of all complaint, office, and periodic tests of watthour meters installed on consumers' premises.

Such record shall include:

Owning company's number.

Manufacturer's name and number.

Type, rated volts, and amperes, and wire.

Date of each installation, removal, and test.

The average of the readings at full load, at light load, and at normal load as found at each and every test, as prescribed by the commission in order adopted October 26, 1909, as amended. Case No. 1154.

A record of tests of each meter shall be continuous for a period of not less than five years, and in any event of sufficient length to cover three consecutive periodic tests.

OREGON

RULE 3. *Records of Tests and Meters.*—(a) A complete record of all tests of quality, service, or meter accuracy as made under these rules, shall be kept by each utility accessible to the public during business hours at the principal office in the town or city where the service is furnished, or at such other place as the commission may designate. The record shall contain complete information concerning each test, including the date and hour when the test was made, the name of the inspector conducting the test, the number of any meter tested and its capacity, the point at which pressure, voltage, or other tests were made when not made at the regular testing laboratory of the utility, the results of the tests, and such other data as may hereinafter in these rules be specifically required or as the commission may from time to time require, or as the utility making the test may deem desirable.

(b) Whenever any service meter is tested, the original test record shall be preserved, indicating the information necessary for identifying the meter, the reason for making the test, the reading of the meter before being disturbed, and the accuracy of measurement, together with all data taken at the time of the test, in sufficiently complete form to permit the convenient checking of the methods employed and the calculations.

(c) A record shall also be kept, numerically arranged, indicating approximately when each meter was purchased, its size, its identification, its various places of installation and removal, and the dates and general results of all tests.

PENNSYLVANIA

RULE 13. *Meter Records.*—Each utility shall maintain a record of all its service watthour meters, which record shall show the name of the manufacturer, the type, the rating, and the date of purchase. When purchased after July 1, 1914, the date and location of all installations in service and the removals therefrom, the date of all tests and the reasons therefor, and the error "as found" and "as left." This record shall be kept as specified in rule 10 and shall be complete and up to date within three years subsequent to July 1, 1914.

RULE 17. *Meters in Service Without Test Records.*—All watthour meters in service on and after July 1, 1914, for which there is no record of test within the time equal to the period of test for that class of meter as specified in rule 16 shall be tested as soon thereafter as circumstances will permit. In no case shall the time subsequent to July 1, 1914, exceed the length of the period of test for meters of that class and rating as specified in rule 16.

WASHINGTON

RULE 6. A complete record of all the meter tests made under these rules shall be kept by each gas, electric, and water company, accessible to the public during business hours at its principal office in the town or city where the service is furnished or at such place as the commission may designate. The records so kept shall contain complete information concerning the result of each test, showing the date and hour upon which the test was made, the name of the inspector conducting the test, the capacity and number of the meter, and the percentage of accuracy obtained by the test, and such other data as the company may deem desirable.

WEST VIRGINIA

RULE 17. *Meter Records and Reports.*—(a) Every utility furnishing metered service shall keep a record (1) of the names and addresses of all its consumers, with the utility's serial number of the meter or meters used by each of them, (2) of all its meters, showing date of installation and removal, name of manufacturer, serial number, type, meter constant, and transformer ratio.

(b) The meter records of every utility shall be available for examination at any time by the commission, its engineers, or inspectors. Every utility shall file with the commission such reports of meters tested as the commission may from time to time require.

(c) Every utility shall report to the commission on or before June 30, 1916, the types and number of every type of meters in its service, and yearly thereafter.

Whenever a utility places any new type of meter in service, this type must be reported to the commission as soon as practicable.

WISCONSIN

No. 18. *Meter Test Records.*—Whenever an electricity meter is tested the original test record shall be kept indicating the information necessary for identifying the meter, the reasons for making the test, the reading of the meter before being disturbed, a statement regarding creepage and the accuracy of measurement together with all data taken at the time of the test. This record must be sufficiently complete to permit the convenient checking of the methods and the calculations. All utilities having more than 250 electricity meters in service shall maintain a meter record, numerically arranged, indicating approximately when the meter was purchased, its identification, its various places of installation with dates of installation and removal, and the dates and general results of all tests, and shall tabulate the results of tests according to types of meters and intervals of test, compiled monthly and annually.

PERIODIC TESTS OF METERS

ARIZONA

RULE No. 15. Each electric service meter shall be tested at least once in two years, the test to be made by comparing the meter with suitable standards on light-load, half-load, and full-load operation.

CONNECTICUT

RULE E-17. *Periodic Tests.*—(a) Each watthour meter shall be tested according to the following schedule while connected in its permanent position in place of service:

(1) Two and three wire commutating-type and mercury-type meters, not exceeding 50 amperes rated capacity of meter element, shall be tested at least once in every 18 months.

(2) Two and three wire commutating-type meters, exceeding 50 amperes rated capacity of meter element, shall be tested at least once in every 12 months.

(3) Two and three wire single-phase induction-type meters, not exceeding 25 amperes rated capacity of meter element, shall be tested at least once in every 36 months.

(4) Two and three wire single-phase induction-type meters, exceeding 25 amperes rated capacity of meter element, shall be tested at least once in every 24 months.

(5) Self-contained polyphase meters, not exceeding 50 kilovolt-amperes rated capacity, shall be tested at least once in every 12 months.

(6) Self-contained polyphase meters, exceeding 50 kilovolt-amperes rated capacity, shall be tested at least once in every 12 months.

(7) Polyphase meters connected with instrument transformers to circuits in which the connected load is not in excess of 50 kilovolt-amperes shall be tested at least once in every 24 months.

(8) Polyphase meters connected with instrument transformers to circuits in which the connected load exceeds 50 kilovolt-amperes shall be tested at least once in every 18 months.

(b) All watthour meters in service on and after November 1, 1915, for which there is on file at the utility's office no record of test made within the period of time specified for that class and rating of meter in paragraph (a) above, shall be tested as soon as possible. In no case shall the time subsequent to November 1, 1915, exceed the period of test for meters of that class and rating as specified in this rule.

DISTRICT OF COLUMBIA

SECTION 7. *Periodic Tests.*—All continuous-current commutator-type meters installed on consumers' premises shall be tested periodically as follows:

(a) Meters up to and including 50 amperes rated capacity, at least once in every 18 months.

(b) Over 50 amperes and including 150 amperes, at least once in every 12 months.

(c) Over 150 amperes, at least once in every 8 months.

All alternating-current induction-type meters shall be tested periodically as follows:

(d) Single and polyphase meters up to and including 50 amperes rated capacity, at least once in every 30 months.

(e) Over 50 amperes and including 150 amperes, at least once in every 24 months.

(f) Over 150 amperes, at least once in every 12 months.

ILLINOIS

RULE 24. *Meters; Periodic Tests.*—Each watthour meter shall be tested according to the following schedule while connected in its permanent position in place of service:

(a) Two and three wire commutating-type and mercury-type meters up to and including 50 amperes rated capacity of meter element shall be tested at least once in every 18 months.

(b) Two and three wire commutating-type and mercury-type meters of over 50 amperes rated capacity of meter element shall be tested at least once every 12 months.

(c) Two and three wire single-phase induction-type meters up to and including 25 amperes rated capacity of meter element shall be tested at least once every 30 months.

(d) Two and three wire single-phase induction-type meters of over 25 amperes rated capacity of meter element shall be tested at least once every 24 months.

(e) Self-contained polyphase meters up to and including 50 kw rated capacity shall be tested at least once every 18 months.

(f) Self-contained polyphase meters of over 50 kw rated capacity shall be tested at least once every 12 months.

(g) Polyphase meters connected through current transformers, or current and potential transformers, to circuits up to and including 50 kw rated capacity shall be tested at least once every 24 months.

(h) Polyphase meters connected through current transformers, or current and potential transformers, to circuits of over 50 kw rated capacity shall be tested at least once every 18 months.

INDIANA

RULE 17. Each electric service meter shall be tested at least once each year, the test to be made by comparing the meter while connected in its place of service with suitable standards on light-load, half-load, and full-load rate of operation.

MISSOURI

RULE 32. Unless otherwise ordered by the commission, each electric service watt-hour meter installed shall be periodically tested in accordance with the following schedule, or as much oftener as the results obtained may warrant, and adjusted in accordance with the provisions of rule 29.

(a) Induction-type meters having rated current capacities not exceeding 50 amperes, at least once every 24 months.

(b) Induction-type meters having rated current capacities exceeding 50 amperes, at least once in every 12 months.

(c) Commutator-type meters with rated current capacities not exceeding 50 amperes and voltage ratings not exceeding 250 volts, at least once every 12 months.

(d) All other meters at least once every 6 months.

In commutator-type meters having heavy moving elements and sapphire jewels, the number of revolutions of the moving element between tests should not ordinarily exceed 1,000,000.

MONTANA

No. 13. Each electric service meter shall be tested as follows:

All meters under 25 amperes, two and three wires, single phase, to be tested at least once in every 24 months; between 25 and 150 amperes, single phase to be tested at least once in 18 months; meters having a capacity in excess of 150 amperes, single phase, to be tested at least once in 12 months, or more frequently if the average of tests indicates that this should be done. Tests as above shall be made by comparing the meter while connected in its place of service with approved suitable standards.

NEVADA

No. 17. Each electric service meter shall be tested at least once a year; the test to be made by comparing the meter while connected in its place of service with suitable standards, on normal operating loads and on 10 per cent of its rated capacity.

NEW HAMPSHIRE

No. 4. Such electric service meter shall be tested according to the following schedule and adjusted to within 1 per cent at light load and heavy load. The tests shall be made, by comparing the meter, while connected in its permanent position, on the consumer's premises, when practicable, with suitable standards, making at least two test runs at each load of at least 30 seconds each, which agree within 1 per cent.

Single-phase, induction-type meters, having current capacities not exceeding 50 amperes, and polyphase induction-type meters having current capacities not exceeding 25 amperes, shall be tested at least once every 24 months, and as much oftener

as the results shall warrant. During each period of 12 months, until all such meters have been tested, each utility shall test not less than 50 per cent of the meters now in service, those longest in service being tested first; provided, however, that this rule shall not require the testing of any meter within the period fixed by the above schedule after any prior test, if the utility shall have preserved a record of such prior test, and shall prior to September 1, 1914, file with the commission a statement giving the make, type, number, and size of the meter with the date and result of such prior test. All single-phase induction-type meters, having current capacities exceeding 50 amperes, all polyphase induction-type meters having current capacities exceeding 25 amperes, and all commutator-type meters, shall be tested at least once every 12 months, and as much oftener as results obtained shall warrant.

NEW JERSEY

No. 17. (3) All direct-current meters installed upon consumers' premises shall be periodically tested according to the following schedule:

Meters up to and including 25 amperes rated capacity shall be tested at least once in every 18 months.

Meters exceeding 25 amperes, up to and including 500 amperes rated capacity, shall be tested at least once in every 12 months.

Meters exceeding 500 amperes rated capacity shall be tested at least once in every 6 months.

(4) All types of alternating-current induction meters shall be periodically tested as follows:

Single-phase meters, up to and including 25 amperes rated capacity, shall be tested at least once in every 30 months.

Single-phase meters exceeding 25 amperes rated capacity shall be tested at least once in every 24 months.

Polyphase meters, up to and including 150 amperes rated capacity shall be tested at least once in every 24 months.

Polyphase meters exceeding 150 amperes rated capacity shall be tested at least once in every 12 months.

NEW YORK

First District

CASE 1524 (July 9, 1914).—(3) That all direct-current meters installed upon consumers' premises shall be periodically tested according to the following schedule:

Meters up to and including 15 amperes rated capacity shall be tested at least once in every 24 months.

Meters exceeding 15 amperes up to and including 75 amperes rated capacity shall be tested at least once in every 18 months.

Meters exceeding 75 amperes up to and including 450 amperes rated capacity shall be tested at least once in every 12 months.

Meters exceeding 450 amperes rated capacity shall be tested at least once every 6 months.

(4) That all types of alternating-current induction meters shall be periodically tested as follows:

Single-phase meters up to and including 25 amperes rated capacity shall be tested at least once in every 30 months.

Single-phase meters exceeding 25 amperes rated capacity shall be tested at least once in every 24 months.

Polyphase meters up to and including 150 amperes rated capacity shall be tested at least once in every 24 months.

Polyphase meters exceeding 150 amperes rated capacity shall be tested at least once in every 12 months.

OREGON

No. 22. (a) Each watthour meter shall be tested according to the following schedule, and shall be adjusted whenever it is found to be in error more than 1 per cent, the tests both before and after adjustment being made at approximately three-quarters and one-tenth of the rated capacity of the meter. The tests shall be made by comparing the meter, while connected in its permanent position in the premises of the customer, with approved suitable standards, making at least two test runs at each load, of at least 30 seconds each, which agree within 1 per cent.

(b) Single-phase, induction-type meters, having current capacities not exceeding 50 amperes, shall be tested at least once every three years, and as much oftener as the results obtained shall warrant.

(c) Single-phase, induction-type meters, having current capacities exceeding 50 amperes, all polyphase meters having voltage ratings not exceeding 550 volts and current capacities not exceeding 50 amperes, and all commutator meters having voltage ratings not exceeding 550 volts and current capacities not exceeding 50 amperes, shall be tested at least once every 12 months.

(d) All other watthour meters shall be tested at least once every 6 months.

PENNSYLVANIA

No. 16. *Frequency of Periodic Tests.*—Each utility shall make periodic tests of all its watthour meters in service, in accordance with the following schedule:

(a) Two and three wire commutating type and mercury type meters, up to and including 50 amperes rated capacity of meter element, shall be tested at least once every 18 months.

(b) Two and three wire commutating type and mercury type meters of over 50 amperes rated capacity of meter element shall be tested at least once every 12 months.

(c) Two and three wire single-phase, induction-type meters, up to and including 25 amperes rated capacity of meter element, and manufactured prior to January 1, 1907, shall be tested at least once every 30 months. Meters of the same type and rating manufactured since January 1, 1907, shall be tested at least once every 36 months.

(d) Two and three wire single-phase, induction-type meters of over 25 amperes rated capacity of meter element shall be tested at least once every 24 months.

(e) Self-contained polyphase meters, up to and including 50 kw. rated capacity, shall be tested at least once every 18 months.

(f) Self-contained polyphase meters of over 50 kw. rated capacity shall be tested at least once every 12 months.

(g) Polyphase meters, connected through current transformers or current and potential transformers, to circuits up to and including 50 kw. rated capacity, shall be tested at least once every 24 months.

(h) Polyphase meters, connected through current transformers, or current and potential transformers to circuits of over 50 kw. rated capacity, shall be tested at least once in every 18 months.

Whenever the number of meters of any type which registers in error beyond the limits specified in Rule 11 is deemed by the commission to be excessive, then this type shall be tested with such additional frequency as the commission may direct.

WASHINGTON

RULE 25. Each electric service meter shall be tested at least once every two years by the company furnishing the service; the test to be made by comparing the meter with suitable standards, on one-tenth load and full-load rate of operation.

WEST VIRGINIA

RULE 14. *Periodic Tests*.—(a) All types of direct current watthour meters installed upon consumer's premises shall be periodically tested according to the following schedule:

1. Meters up to and including 25 amperes rated capacity shall be tested at least once in every 18 months.
2. Meters exceeding 25 amperes, up to and including 500 amperes, rated capacity, shall be tested at least once in every 12 months.
3. Meters exceeding 500 amperes rated capacity shall be tested at least once in every 6 months.

(b) All types of alternating current induction watthour meters installed upon consumer's premises shall be periodically tested as follows:

1. Single-phase meters, up to and including 25 amperes rated capacity, shall be tested at least once in every 36 months.
2. Single-phase meters, exceeding 25 amperes rated capacity, shall be tested at least once in every 24 months.
3. Polyphase meters, up to and including 50 kw. rated capacity, shall be tested at least once in every 24 months.
4. Polyphase meters, exceeding 50 kw. rated capacity, shall be tested at least once in every 12 months.

(c) All watthour meters in service on and after January 1, 1916, for which there is on file at the utility's office no record of test made within the period of time specified for that class and rating of meter in (a) and (b) above shall be tested as soon as possible. In no case shall the time subsequent to January 1, 1916, exceed the period of test for meters of that class and rating as specified in this rule. For good cause shown, the commission will allow exceptions to this rule in special cases. Where meters are found to register considerably in error when tested on the above schedules, the commission reserves the right to order more frequent tests for that particular utility.

WISCONSIN

No. 17. *Periodic Tests*.—Each watthour meter shall be tested according to the following schedule and adjusted whenever it is found to be in error more than 1 per cent, the tests both before and after adjustment being made at approximately three-quarters and one-tenth of the rated capacity of the meter. Meters operated at low power-factor shall also be tested at approximately the minimum power-factor under which they will be required to operate. The tests shall be made by comparing the meter, when connected in its permanent position, on the consumer's premises, with approved, suitable standards, making at least two test runs at each load of at least 30 seconds each, which agree within 1 per cent.

Single-phase induction-type meters having current capacities not exceeding 50 amperes shall be tested at least once every 24 months and as much oftener as the results obtained shall warrant.

All single-phase induction-type meters having current capacities exceeding 50 amperes, and all polyphase and commutator-type meters having voltage ratings not exceeding 250 volts and current capacities not exceeding 50 amperes, shall be tested at least once every 12 months.

All other watthour meters shall be tested at least once every six months.

In no case shall commutator-type meters having heavy moving elements and sapphire jewels be allowed to make more than 1,000,000 revolutions between tests. Where meters are found to register considerably in error when tested on the above schedule the commission reserves the right to order the particular meter or class of meters tested more frequently.

POLE IDENTIFICATION AND INSPECTION

CONNECTICUT

RULE E-3. *Pole Identification.*—(a) Each utility owning or having the custody and maintenance of a pole, post, or other structure used for supporting electrical conductors shall, on or before October 1, 1916, mark each such pole, post, or other structure with a designating mark or symbol indicating the utility so owning or having the custody and maintenance thereof, and a number by which the location of each such pole or other structure may be described; provided, however, that such utilities will not be required to mark more than every fifth pole upon a through or trunk line of poles in a rural district; and provided further, that the mark of no utility other than the one owning or having the custody and maintenance shall be required on jointly used poles.

(b) Each such utility shall mark in similar manner all such structures subsequently erected or coming under its ownership or control.

(c) Each such company shall within 30 days from date hereof submit for the approval of the commission its proposed method of complying with the provisions of paragraph (a) hereof.

(As revised Feb. 2, 1916.)

NEW JERSEY

4. *Pole Identification.*—(a) Each utility owning poles supporting wires along or over public highways, this to include each railroad, street railway, telephone, telegraph, and electric light and power utility, shall, on or before January 1, 1915, stencil each pole, post, or other structure similarly used with—

(1) The initials of its name, abbreviation of its name, corporate symbol, or other distinguishing mark by which the owner of each such structure may be readily and definitely determined.

(2) A number by which the location of each such structure may be described.

(b) The manner of making such stencils shall be with paint, and the characters of the stencil shall be of such size and so spaced and hereafter maintained as to be easily read from the surface of the ground at a distance of 10 feet from the structure.

(c) In the case of two or more utilities jointly owning any such structure the distinguishing mark of each utility shall be placed on such structure, but not more than one number necessarily shall be placed thereon.

(d) In the case of such structures carrying or supporting overhead trolley wires where there is a double line of structures, one on each side of the railroad track, such stencil need be affixed to but one line of such structures.

(e) In the case of such structures erected upon private rights of way or on the public highways of such character that the construction may be deemed to be a through or trunk line, such stencil need be affixed only to every fifth structure; provided, however, that each and every structure situated within the limits of any built-up community shall be stenciled, except as otherwise provided in paragraph (d).

(f) The requirements herein shall apply to all existing and future erected structures and to all changes in ownership.

(g) Every such utility shall file with the board of public utility commissioners, in duplicate, on or before March 1, 1914, a statement showing—

(1) The initials, abbreviation of name, corporate symbol, or distinguishing mark.

(2) The means of stenciling to be employed.

(3) The method intended to be followed in numbering structures, to wit, within the limits of cities, towns, or other built-up communities, and upon through or trunk lines.

5. *Pole Inspection.*—Each pole, post, tower, or other structure used for the support or attachment of wires, guys, or lamps must be inspected by the utility owning or

using it with sufficient frequency and comprehensiveness to determine in each specific case the necessity for replacement or repair.

The inspector shall be guided by the specifications referred to in Article 3 (p. 100) of these rules, and also for the guidance of the inspector reference is hereby made to the general rules for pole replacement inspection of the American Telephone & Telegraph Co.

NEW YORK

Second District

CASE No. 2499. *Ordered:* 1. That each and every electrical corporation, municipality, telephone corporation, telegraph corporation, railroad corporation, and street railroad corporation owning poles, towers, or frames hereinafter termed "structures," in streets, highways, or public places, or on private rights of way, for supporting and carrying overhead electric wire systems for the transmission or distribution of electric energy for light, heat, or power, or for the operation of electric cars or trains, or for telephoning or telegraphing, or for supporting electric lamps or fixtures, shall on or before January 1, 1913, stencil each such structure, except as hereinafter provided, as follows: to wit, (a) with the initials of its name, abbreviation of its name, corporate symbol, or other distinguishing mark by which the owner of each such structure readily and definitely may be determined; (b) with a number by which the location of each such structure may be described.

Ordered: 2. That the manner of making such stencils shall be preferably with paint, otherwise with metal tags, badges, or stamps as each such corporation may elect to use; and that the characters of the stencil shall be of such size and so spaced and hereafter maintained as to be easily read from the surface of the ground at a distance of 6 feet from the structure.

Ordered: 3. That in case of two or more companies jointly owning any such structure, the distinguishing mark of each company shall be placed on such structure but not more than one number necessarily shall be placed thereon.

Ordered: 4. That in the case of such structures carrying or supporting overhead trolley wires where there is a double line of structures, one on each side of the railroad track, such stencil need be affixed to but one line of such structures.

Ordered: 5. That in the case of such structures erected upon private rights of way or on the public highways of such character that the construction may be deemed to be a through or trunk line, such stencil need be affixed only to every fifth structure; provided, however, that each and every such structure situate within the limits of any city, village, or hamlet shall be stenciled, except as otherwise provided in paragraph 4 herein. Where every fifth structure is stenciled, the commission suggests that the number of the mile from the starting point of the construction be placed on the structure stenciled, and also the number of every fifth structure within that mile. And the commission further suggests that all such structures situate within the limits of every city, village, and hamlet shall be numbered consecutively along each street, avenue, or highway for the distance upon which structures are located.

Ordered: 6. That the requirements herein shall apply to all existing and future constructed structures and to all changes in the ownership of structures.

Ordered: 7. That every such corporation shall file with this commission on or before May 1, 1912, a statement showing—

(a) The initials, abbreviation of name, corporate symbol, or other distinguishing mark, intended to be used;

(b) The means of stenciling to be employed: to wit, paint, metal tags, badges, or stamps;

(c) The method intended to be followed in numbering structures: to wit, within the limits of cities, villages, and hamlets; and upon through or trunk lines.

WEST VIRGINIA

RULE 5. Pole identification.—(a) Every utility owning poles, posts, or other structures, supporting wires, shall on or before June 1, 1916, mark every such structure when located within a built-up community with—

(1) The initials or abbreviation of its name, corporate symbol, or other distinguishing mark by which the owner of every such structure may be readily determined.

(2) The number by which the location of every such structure may be described.

(b) When such structure is located outside of a built-up community, only every fifth structure shall be so marked and numbered.

(c) Such marks shall be made with paint, stamps or brands, as the utility may elect to use, and the characters of the mark shall be of such size and so spaced and hereafter maintained as to be easily read from the surface of the ground at a distance of 6 feet from the structure.

(d) In the case of two or more utilities jointly owning any such structure, the distinguishing mark of every utility shall be placed on such structure, but not more than one number necessarily shall be placed thereon.

(e) In the case of such structures carrying or supporting overhead trolley wires where there is a double line of structures, one on each side of the railroad track, such marks need be affixed to but one line of such structures.

(f) In the case of such structures erected upon private rights of way or on the public highways of such character that the construction may be deemed to be a through or trunk line, such marks need be affixed only to every fifth structure; provided, however, that every such structure situated within the limits of any built-up community shall be marked, except as otherwise provided in paragraph (e).

(g) The requirements herein shall apply to all existing structures and those hereafter erected, and to all changes in ownership.

(h) Every such utility shall file with the commission in duplicate on or before October 1, 1915, a statement showing:

1. The initials, abbreviation of name, corporate symbol, or distinguishing mark.

2. The means of marking to be employed.

3. The method intended to be followed in numbering structures (1) within the limits of cities, towns, or other built-up communities, and (2) outside of such communities.

RULE 6. Pole inspection.—Every pole, post, tower, or other structure used for the support or attachment of wires, guys, or lamps, must be inspected by the utility owning or using it with sufficient frequency to determine the necessity for replacement or repair.

The inspector should be guided by the specifications referred to in rule 4.

REFEREE OR COMMISSION TESTS; FEES

CONNECTICUT

RULE 5. Tests of Meters by Request of Customers.—(b) Section 20, chapter 128, public acts of 1911, provides that—

“Upon petition of any person, and the payment by such person of a fee of \$1 for each meter, the commission shall cause to be inspected any electric, gas, or water meter used in measuring electricity, gas, or water supplied to such petitioner. The company supplying electricity, gas, or water through such meter shall reimburse the petitioner for said fee if such meter be found to be more than 2 per cent fast in the case of a gas meter, or 4 per cent fast in the case of an electric or water meter, and shall not again use such meter until corrected and approved by the commission. The commission shall cause to be approved every electric, gas, or water meter in which the

error does not exceed 2 per cent for gas meters or 4 per cent for electric or water meters, and shall cause the same to be stamped with some suitable device and the date of approval."

(c) After notification by the commission of the test impending under the provisions of the preceding paragraph *b* the utility shall neither adjust, disturb, nor remove the meter in question, except as directed by the authorized representative of the commission.

(d) For the purposes of rule 5b the commission will be inclined to determine the average error of a meter by taking one-fifth of the sum of (1) the error at approximately full-rated or maximum capacity, (2) the error at light load or rate, (3) three times the error at normal or nominal rated capacity.

DISTRICT OF COLUMBIA

SECTION 10. *Referee Tests.*—Upon application of any consumer to the Electrical Inspection Bureau, a test shall be made of the consumer's meter by the bureau after deposit by the consumer of the prescribed fee. If, upon test, the meter is found to have an error in registration not in excess of 4 per cent or to read slow, the fee deposited by the consumer at the time of making application for the test will be kept. If, upon test, the meter is found to read fast in excess of 4 per cent on any of the three loads prescribed herein, the fee deposited by the consumer will be returned and the prescribed fee shall be paid by the electrical corporation owning the meter.

SECTION 11. Upon application of an electrical corporation to the Electrical Inspection Bureau, a meter shall be tested by the bureau and the prescribed fee shall be paid therefor by the said corporation.

SECTION 12. *Fees and Records.*—The prescribed fees for referee tests of meters shall be as follows: One dollar for each meter not exceeding 50 amperes rated capacity; \$2 for each meter of greater capacity.

SECTION 13. The Electrical Inspection Bureau shall keep a complete record of each test of a meter made by it and of all fees due and received for such testing. All such fees shall be paid by the bureau to the collector of taxes of the District of Columbia for payment into the Treasury of the United States to be placed to the credit of the United States and the District of Columbia in equal parts.

ILLINOIS

RULE 25. *Referee Test.*—Any service watthour meter will be tested by an inspector employed by the commission upon written application by the consumer. For such a test a fee shall be forwarded to the commission by the consumer when making application, which fee shall be refunded to the consumer by the utility if the meter be found more than 4 per cent fast, the average in measurement being calculated as specified in rule 21.

The schedule of fees for referee tests of watthour meters is as follows:

- (a) For continuous current and single-phase meters operating on 600 volts or less, up to and including 25 amperes rated capacity of the meter element, each \$2. 00
- (b) For each additional 50 amperes or fraction thereof 50
- (c) For single-phase meters above 600 volts, and for polyphase meters with or without instrument transformers, up to and including 25 kw. rated capacity of the circuit 3. 00
- (d) For each additional 25 kw. rated capacity, or fraction thereof 3. 00

INDIANA

NO. 21. Upon formal application of any consumer to the Public Service Commission, a test shall be made upon the consumer's meter by an inspector employed by the Public Service Commission, and test to be made as soon as practicable after the receipt of the application. For such test a fee of \$2 shall be paid by the consumer making application for the test if the meter is found to be slow or correct within the allowable limit and by the company owning the meter if the meter is found to be beyond the allowable limit.

MISSOURI

RULE 34. Any electric service meter will be tested at the laboratories of the School of Engineering of the State University at Columbia, Mo., upon written application to the dean of the School of Engineering for such test.

Meter to be tested must be removed and packed by or with the consent of the utility furnishing electric service, but the consumer shall be given an opportunity to witness the disconnection, packing, and shipment of same should he so desire.

The meter will be returned from the engineering laboratories with a special seal which, if the meter is to be again installed on this consumer's premises, shall not be disturbed until after the consumer has been given an opportunity to inspect same.

A test fee of \$2 will be charged for each single-phase or direct-current watthour meter having a current capacity not exceeding 25 amperes and without instrument transformers. For other meters a proportionally larger fee will be charged, depending upon the type and size of the meter.

If the meter is fast beyond the prescribed limit in rule 31, the utility will be required to pay the test fee and cost of shipping meter. Otherwise these expenses shall be borne by the consumer requesting the test.

MONTANA

NO. 22. If a consumer is dissatisfied with the test made by the utility, and makes written application to the Public Service Commission, a test shall be made on the consumer's meter by an inspector employed by the Public Service Commission, such test to be made as soon as practicable after receipt of the application. For such a test a fee covering the actual expense (minimum \$2) shall be paid by the consumer making the application for the test if the meter is found to be slow, or correct within the allowable limit, and by the company owning the meter if the meter is found to be fast beyond the allowable limit.

NEVADA

RULE 21. Upon formal application of any consumer to the Public Service Commission a test shall be made upon the consumer's meter by an inspector, employed by the commission, such test to be made as soon as practicable after the receipt of the application. For such a test a fee of \$1.50 shall be paid by the consumer making application for the test if the meter is found to be slow or correct within the allowable limit, and by the company owning the meter if the meter is found to be fast beyond the allowable limit.

NEW HAMPSHIRE

RULE 6. Any electric service meter may be tested by an inspector employed by the commission, upon written application of the consumer, and payment of the cost of inspection to the commission. If the meter is found to be more than 4 per cent fast the amount paid by the consumer will be returned to him and shall then be paid by the utility. Each such application shall be accompanied by a fee of \$1, which is fixed as the fee for testing upon complaint any meter with a voltage rating not exceed-

ing 250 volts, and a current capacity not exceeding 25 amperes within village or city limits upon any railroad.

For testing other meters a fee equal to the estimated cost to the commission will be required.

NEW JERSEY

No. 26. Upon formal application by any customer to the Board of Public Utility Commissioners a test shall be made of the customer's meter by an inspector employed by the board. Such test shall be made as soon as practicable after receipt of the application. For such a test a fee of \$1 shall be paid by the customer at the time application is made for the test; this fee to be retained if the meter is found to be slow or correct within the allowable limits. If the meter is found to be fast beyond the allowable limits the amount of \$1 will be refunded to the customer and collected from the utility owning the meter.

The utility owning the meter will be notified that such test is to be made, and should have a representative present to open the meter and seal it after the test.

OREGON

RULE 5. (b) Any customer may at any time make application to the commission for a test of his meter and shall deposit with the commission a fee for such test, fixed as hereinafter in these rules provided. Such fee shall be returned to the customer by the commission, and the amount thereof paid by the utility to the commission, if the meter is found to be fast in excess of the following limits, viz:

- Gas meters (when passing gas at the rate of 6 cubic feet per hour per rated light capacity), 3 per cent.
- Electricity meter, 4 per cent.
- Water and other meters, 2 per cent.

RULE 23. *Fees for Meter Tests.*—(a) The amount of fee to be collected for meter tests made in accordance with the provisions of paragraph (b) of rule 5 shall be as follows:

For each single phase or continuous current electricity meter having a voltage rating of not exceeding 250 volts and a current capacity not exceeding 25 amperes without having instrument transformers..... \$2. 00
 For other electricity meters having a capacity not exceeding 100 amperes..... 4. 00
 For all other electricity meters..... 8. 00

WASHINGTON

RULE 5. If any consumer of gas, electric current, or water desires any meter test other than that provided for in the preceding rule [see Washington, under "Request tests"] said consumer shall first make application to the company who shall have 10 days within which to make said test and report the result thereof to the consumer, or to refuse altogether to make said test. Should the company refuse to make said test, or should the consumer not be satisfied with the accuracy of any test made by the company, the consumer may then make formal application to the commission, who shall cause such test to be made by an inspector appointed by the commission as soon as practicable after the receipt of the application. For such test made by the commission a fee of \$3 shall be paid by the consumer making the application if the meter is found to be slow or correct within the allowable limit, and by the company owning the meter if the meter is found to be fast beyond the allowable limit.

WEST VIRGINIA

RULE 16. Complaint Tests.—Upon formal written application to the Public Service Commission by any consumer a test shall be made upon the consumer's meter by an inspector of the commission. A report giving the results of the test shall be made to the consumer and the company, and a complete record of the test shall be kept in the office of the chief inspector of the commission. If the said meter shall be found to register not more than 2 per cent fast the cost of such inspection shall be borne by the consumer, but if the meter shall be found to register incorrectly to the consumer's prejudice, more than 2 per cent, the cost of such inspection shall be borne by the utility.

All inspections shall be made as soon as practicable. The charges fixed by the commission for making such tests are as follows:

- A. For direct-current watthour meters and single-phase alternating-current watthour meters operating on constant-potential circuits of not over 250 volts:

<i>Amperes rated capacity:</i>	Fee
30 and under	\$1. 50
Over 30 to 100	3. 00
And for each additional 50 amperes or fraction thereof	. 75

- B. For polyphase alternating-current watthour meters and for single-phase or direct-current watthour meters operating on circuits of over 250 volts, with or without instrument transformers:

<i>Kilowatts rated capacity:</i>	
5 kw. and under	2. 00
Over 5 to 25	3. 00
Over 25 to 100	6. 00
Over 100 to 500	15. 00
Over 500	30. 00

If a test is required on any meter not included in either of the above classifications, the commission will establish the fee therefor on application.

NOTE.—For the determination of the average percentage of accuracy the following rule is recommended as an equitable method:

All meters, whenever possible, shall be tested at two loads, one-tenth of the full rated capacity of the meter, and full-rated capacity of the meter.

The average of these tests shall be deemed the condition of the meter.

WISCONSIN

No. 21. Any electricity meter may be tested by an inspector employed by the commission, upon written application of the consumer. For such a test a fee shall be forwarded to the commission by the consumer when making application; the amount of this fee shall be refunded to the consumer by the utility if the meter is found to be fast beyond the 4 per cent limit. The amount of fee to be collected for these tests so made shall be \$2 for each single-phase or continuous-current electricity meter having a voltage rating not exceeding 250 volts, and a current capacity not exceeding 25 amperes without having instrument transformers; for other electricity meters having a capacity not exceeding 100 amperes the test fee shall be \$4 per meter; for all others the fee shall be \$8 per meter.

REFUNDS AND BILL ADJUSTMENTS

CONNECTICUT

RULE 6. *Adjustment of Bills for Meter Errors.*—(a) Whenever the test of a meter under rule 5 reveals it to be fast beyond the limits prescribed, the utility shall refund to the customer such percentage of the amount of the bills covering metered consumption for the previous six months, as the meter was found to be in error at the time of the test, unless it can be shown from the records of the utility or complainant that the error found has been extant for a greater or lesser period, in which case the refund shall cover such actual period.

ILLINOIS

RULE 4. *Adjustment of Bills for Meter Errors.*—If on any test of a service meter, either by the utility or by the commission, such meter shall be found to have a percentage of error greater than that allowed in rule 11 (c) for gas meters, or rule 22 (e) for watthour meters, the following provisions for the adjustment of bills shall be observed:

(a) *Fast Meters.*—If the meter is faster than allowable, the utility shall refund to the consumer a percentage of the amount of his bills for the six months previous to the test or for the time the meter was installed, not exceeding six months, corresponding to the percentage of error of the meter.

(b) *Slow Meters.*—If the meter is found not to register or to run slow, the utility may render a bill to the consumer for the estimated consumption during the preceding six months, not covered by bills previously rendered, but such action shall be taken only in cases of substantial importance where the utility is not at fault for allowing the incorrect meter to be in service. (See p. 76.)

NEW HAMPSHIRE

RULE 8.^{50c} Whenever a meter is tested under rules 5, 6, or 7 and is found to be more than 4 per cent fast, the utility shall refund to the consumer such percentage of the amount of bills for the previous six months, or for the time the meter was in service or since the last preceding test not exceeding six months, as the meter was found to be in error at the time of test; provided, however, that the commission in any case may relieve the utility from this requirement to such extent as the facts may appear justly to require. Whenever a meter so tested is found to be more than 4 per cent slow, the utility may make application to the commission for authority to render a bill to the consumer for electricity supplied during the preceding six months, not covered by bills previously rendered; but such application should be made only in cases of substantial importance, and should be accompanied by a statement showing the utility not to be in fault for allowing the incorrect meter to be in service.

OREGON

RULE 6. *Adjustments of Bills for Meter Errors.*—(a) If on test of any meter, for any cause, either on removal from or while in service, it shall be found fast beyond the limits specified in rule 5b, the utility shall refund to the consumer such percentage of the amount of the bills to the customer for the period of three months just previous to such test of the meter as the meter shall have been shown to be in error at the time of said test. If the meter is found not to register or to register less than 50 per cent of the actual consumption, an average bill may be rendered to the customer by the utility, subject to the approval of the commission. (See p. 133.)

^{50c} This rule shall not be taken to require the refund of any part of a minimum service or demand charge.

PENNSYLVANIA

No. 24. *Refund for Overcharge*.—If a meter be found to be fast by more than 4 per cent as defined in rule 12 at any test, an allowance or refund shall be made to the consumer by the utility, equal to all the excess charged the consumer, figured back from the date of test through the entire period of the current bill, unless it can be shown that the error is due to an accident or other cause, the exact time of which is known, in which case it shall be figured back to such time. (See p. 79.)

WEST VIRGINIA

RULE 31. *Refunds*.—Whenever a meter in service is found upon periodic, request, or complaint test to be more than 2 per cent fast, additional tests shall at once be made as stipulated in "note" of rule 16, so as to determine the average error of the meter.

Whenever a meter is found to have an average error in registration exceeding 2 per cent as above defined, the utility shall refund to the consumer such a percentage of the amount of the bills for a period equal to one-half of the time elapsed since the last previous test, as the meter is found to be in error at the time of the test, but in no case exceed three months; provided, however, that the commission may relieve the utility from this requirement in any particular case to any extent that the facts may appear justly to require.

Similarly, when a meter is found to be more than 2 per cent slow by like tests, the utility may make application to the commission for authority to render a bill to the consumer for electricity supplied, during a period equal to one-half of the time elapsed since the last previous test, not covered by bills previously rendered; but said application should be made only in cases of substantial importance, and should be accompanied by a statement of all the facts in the case. (See p. 134.)

REPLACEMENT OF METERS

NEW JERSEY

No. 28. No utility shall make any charge for replacing a meter where such replacement is required by a customer, unless the meter first referred to has been in use less than one year, in which case a charge, which in no case shall exceed \$1, may be made to cover the actual expense of making the change.

REPORTS AND RECORDS

ARIZONA

It is ordered that all electric, gas, water, and street railway corporations operating utilities in the State of Arizona shall keep all books, records, and accounts of all kinds at some convenient location within the State of Arizona, preferably at the place of doing business or their local office or headquarters.

CONNECTICUT

RULE E-18. *Report on Types of Meters*.—(a) Each utility shall report in duplicate to the commission before January 31, 1916, the types and quantity of each type of meters in its service, and yearly thereafter. Whenever a utility places any new type of meter in service, this type must be promptly reported and described to the commission.

DISTRICT OF COLUMBIA

SECTION 8. Each corporation shall keep a complete record of each request, periodic, and inquiry (or office)^{60d} test made by it of meters installed on consumers' premises. Such records shall include: Owning corporation's number, manufacturer's name and number, type, rated volts and amperes, wire, and the average readings at light load, at normal load, and at full load.

Each corporation shall keep a record of the dates on which its meters are installed in and removed from the service of consumers.

SECTION 9. Each corporation shall submit to the commission in the form prescribed by the commission a monthly report of the results of all tests of meters made during that month. Such reports shall be made for the calendar month and shall be submitted not later than the 15th of the month following.

ORDER NO. 140. (1) That the attached blank form⁶¹ is hereby adopted by the commission as a form for the use of utilities in furnishing the information necessary.

(2) That each utility delivering electricity to commercial customers or using or delivering electricity for the operation of street railways in the District of Columbia shall hereafter furnish to the commission the information for each month called for on the said blank form not later than the 25th day of the month following.

(3) That this order shall take effect immediately and shall continue in force until otherwise ordered by the commission.

ILLINOIS

RULE I. *Records and Reports.*—All records required by these rules shall be preserved for at least three years after they are made. Such records shall be kept within the State at an office or offices of the utility located in the territory served by it and shall be open for examination by the commission or its representatives. Each utility shall notify the commission of the office or offices at which the various classes of records are kept and shall file with the commission such reports as the commission may from time to time require.

NEW HAMPSHIRE

RULE 18. Each utility at such times and in such form as the commission shall require shall report to the commission the result of voltage surveys, interruptions of service, and the number of meters purchased, installed, removed from service, and tested.

NEW JERSEY

RULE 24. Complete records shall be kept in the local office of all periodic tests and tests on old meters brought in. These records shall be available for examination at any time by the inspectors of the board.

A report shall be made to the board at stated intervals giving a summary of the tests. Each utility having more than 500 meters shall report monthly. Utilities having less than 500 meters shall report quarterly. Blank forms will be furnished by the board on which reports are to be made.

^{60d} An inquiry (or office) test is a test of a watthour meter in its permanent position on a consumer's premises made by and at the instance of an electrical corporation for the purpose of investigating the cause of apparently abnormal registration.

⁶¹ The form referred to is a statement showing kilowatt hours generated, used, and delivered during each month. The items to be listed are: Delivered to commercial customers; used by or delivered to each street railway company; kilowatt hours used or delivered for any purpose not specifically stated herein; kilowatt hours delivered for street and park lighting; total kilowatt hours accounted for; total kilowatt hours unaccounted for; total kilowatt hours generated; average cost per kilowatt hour generated.

NEW YORK

First District

CASE 1154. SEC. 1. Every electrical corporation operating within the first district shall file with the Public Service Commission for the said district monthly reports, in the form hereinafter prescribed, stating the results of all tests of watthour meters tested for accuracy during that month. * * *

SEC. 2. Such reports shall be made for the calendar month and shall be filed not later than the 15th of the following month.

SEC. 3. All tests shall be made pursuant to the rules and regulations hereinafter prescribed.

SEC. 17. All reports of complaint, periodic and office tests, shall be made in the form designated "Complaint, Periodic and Office Tests," hereto attached.

NEW YORK

Second District

BULLETIN E. II.—1. Report of tests shall be made to the commission not later than the 10th day of each month, covering tests made during the last preceding calendar month, upon the report forms furnished by the commission.

2. If no meters are tested, the monthly report shall be filed with indorsement to that effect.

RESOLUTION OF JUNE 23, 1908.—*Resolved*, That each and every electrical corporation provided with apparatus for testing the accuracy of electric meters furnished to its consumers, be, and is hereby, required to report to the commission the customers' meters tested each month with such apparatus, beginning with the month of August, 1908; that such reports be made in form prescribed by the commission not later than the 10th day of the following month, and that the tests so reported be made pursuant to the rules and regulations of the commission.

PENNSYLVANIA

No. 7. *Maintenance and Inspection*.—Each utility shall maintain its equipment and facilities, and shall make periodic inspection of same, all in accordance with good practice, and in a manner satisfactory to the commission. Each utility shall also keep a complete record of all such inspections, as specified in rule 10, and shall file with the commission a statement of the condition of the equipment and facilities, and such copies of the reports of inspections, when and in such form as the commission may require.

No. 10. *Records and Reports*.—All records required by these rules shall be kept within the State at an office or offices of the utility located in the territory served by it, and shall be open for examination by the commission of the office or offices at which the various classes of records are kept, and shall file with the commission such reports as the commission may from time to time require.

WEST VIRGINIA

RULE 34. *Reports to Commission*.—Every utility shall make special reports at such time and in such form as the commission may from time to time require.

REQUEST TESTS BY CUSTOMER**ARIZONA**

RULE 18. Each utility supplying electrical energy shall make a test, upon request of a consumer, of a meter, provided such consumer does not make a request for a test more frequently than once in twelve months; and further provided that the meter in question has not been tested within the previous twelve months by the utility or by the State or city sealer of weights and measures. When an application is made by a consumer for a meter test within the period of less than twelve months, above referred to, the utility shall refer the consumer to the State or city sealer of weights and measures to whom application can be made by the consumer for a meter test. The fee for making a test of an electric meter by the State or city sealer of weights and measures shall be the sum of \$1, and shall be advanced by the party demanding the test; but in case the meter be already in use and found to be measuring too fast by as much as 3 per cent, the sealer shall return the fee to the consumer, and said fee shall be and become a lawful charge against the furnisher. A report of the result of the test made by the utility at the request of the consumer shall be made to the consumer, and a complete record of all such tests shall be kept on file at the office of the utility.

CONNECTICUT

RULE 5. *Tests of Meters by Request of Customers.*—(a) Each utility shall, upon the written request of a customer, and, if he so desires, in his presence or that of his authorized representative, make without charge a test of the accuracy of the meter in use at his premises; provided, first, that the meter has not been verified by the utility or by the commission within the period of one year previous to such request; and, second, that the customer will agree to abide by the results of such test as the basis for the adjustment of disputed charges. A written report of the results of the test shall be furnished to the customer by the utility.

DISTRICT OF COLUMBIA

SECTION 6. *Request Tests.*—Each corporation shall, without charge, make a test of the accuracy of a meter upon request of a consumer, provided that the meter in question has not been tested by either the corporation or the commission within six months previous to such request. A report giving the results of the test shall be furnished to the consumer.

ILLINOIS

RULE 3. *Request Tests.*—Each utility furnishing metered service shall make a test of the accuracy of any meter upon written request by a consumer; provided, first, That the meter in question has not been tested by the utility or by the commission within six months previous to such request; and, second, that the consumer will agree to accept the result of the test made by the utility as determining the basis for settling the difference claimed. No charge shall be made to the consumer for any such test. A report giving the result of every such test shall be made to the consumer.

INDIANA

No. 20. Each company supplying electrical energy shall make a test of the accuracy of a meter upon request of a consumer, provided such consumer does not make request for tests more frequently than once in six months. A report giving the results of such tests shall be made to the consumer, and a complete record of the same shall be kept on file in the office of the company.

MISSOURI

RULE 33. Each utility furnishing metered electric service shall make a test of the accuracy of any electric service meter free of charge upon request of a consumer, provided that the meter has not been tested within six months previous to such request. The consumer shall be notified of the time and place of such test so that he may be present to witness same should he so desire.

A written report, giving the result of such request test, shall be made to the consumer requesting same, the original record being kept on file at the office of the utility under the provisions of rule No. 2. (See p. 120.)

MONTANA

No. 21. Each gas or electric company shall make a test of the accuracy of a meter upon request of a consumer, provided such meter has not been tested by the utility or by the commission within a period of one year preceding the request. A report giving the results of such tests shall be made to the consumer, and a complete record of such tests shall be kept on file in the office of the company. Settlement for overcharge, if such is found to exist, shall be made on basis of the disclosed error, and for a period of time covering one-half of the interim since date of last test, unless it is shown conclusively that the irregularity existed for some definite period.

NEVADA

RULE 20A. Each company supplying electrical energy shall make a test of the accuracy of a meter upon request of a consumer, provided such consumer does not make request for tests more frequently than once in six months. Such test shall be made in the presence of the consumer, with meter connected in its place of service, and such meter shall not be uncovered for adjustment until settlement of complaint is made. A report giving the results of such tests shall be made to the consumer, and a complete record of the same forwarded to the Public Service Commission.

NEW HAMPSHIRE

RULE 5. Each utility furnishing metered electric service shall make a test of the accuracy of any electric service meter upon the request of the consumer, made at the office of the utility, provided the consumer does not request such test more frequently than once in six months. A report giving the results of each request test shall be made to the consumer.

NEW JERSEY

No. 25. Each electric utility shall, without charge, make a test of the accuracy of a meter upon request of a customer, provided such customer does not make a request for test more frequently than once in six months. A report giving results of such tests shall be made to the customer, and a complete record of such tests shall be kept on file at the office of the utility.

OREGON

RULE 5. (a) Each utility shall, at any time when requested by a customer test the accuracy of the meter in use by him free of charge, provided such meter has not been tested by the utility or by the commission within the period of one year immediately preceding the request.

PENNSYLVANIA

No. 18. Request Tests.—Each utility shall upon the written request of a consumer, and if he so desires, in his presence or that of his authorized representative, make a test of the accuracy of his meter. When a consumer desires either personally or by

a representative, to witness the testing of a meter, he may require the seal of the meter to be broken only in his presence or that of his representative. If the meter so tested shall be found to be accurate within the limits specified in rule 11 a fee determined from the schedule indicated below shall be paid to the utility by the consumer requiring such test; but if not so found then the cost thereof shall be borne by the utility furnishing the service. When making such request the consumer shall agree to the basis of payment herein specified. A report of such test shall be made to the consumer, and a complete record of such test shall be kept on file as specified in rule 10.

Schedule of Fees for Testing Watthour Meters

- (a) For direct current and single phase meters operating on 600 volts or less, up to and including 25 amperes rated capacity of the meter element \$1. 50
- (b) For each additional 50 amperes or fraction thereof 50
- (c) For single phase meters above 600 volts and for polyphase meters with or without instrument transformers, up to and including 25 kw. rated capacity of the circuit 2. 50
- (d) For each additional 25 kw. rated capacity or fraction thereof 2. 50

Rates for meters not included in the above classification, or so located that the cost is out of proportion to the fee specified will be furnished by the commission upon receipt of complete specifications.

WASHINGTON

NO. 4. Each company supplying gas, electric current or water shall make a test of the accuracy of a meter upon request of a consumer, and within 10 days thereafter, free of charge, provided such consumer does not make a request for a test more frequently than once in 12 months.

WISCONSIN

RULE 20. Each utility furnishing metered electric service shall make a test of the accuracy of any electricity meter upon request of the consumer, provided the consumer does not request such test more frequently than once in six months. A report giving the results of each request test shall be made to the customer and the complete original record kept on file in the office of the utility.

WEST VIRGINIA

RULE 15. *Request Tests.*—Every utility furnishing metered electric service shall make a test of the accuracy of any electricity meter upon request of the consumer, provided the consumer does not request such test more frequently than once in 12 months. If said meter shall be found to register not more than 2 per cent fast the consumer shall pay a fee of 50 cents to the utility. A report giving the result of each request test shall be made to the consumer and to the Public Service Commission and the complete original record shall be kept on file in the office of the utility for at least three years.

STATION RECORDS ⁵²

CONNECTICUT

RULE E-9. *Switchboard Records.*—(a) Each utility shall keep a record of the time of starting and shutting down the generating units and feeders, together with the indication of the proper switchboard instruments at sufficiently frequent intervals to show the characteristics of the load.

⁵² See also "Interruptions of service," p. 97.

ILLINOIS

RULE 29. Station Records.—Each utility shall keep a station record which shall show: The time of starting and shutting down all generating units; the time of starting and disconnecting all street-lighting circuits; the readings of such instruments at each generating station and at such intervals as are necessary to determine the character of the load; all interruptions to service affecting the busbars or distribution system, with the time, duration, extent and the cause, when known, of the interruption. An interruption is here defined, for the purpose of record only, as the interval of time during which the voltage falls below 50 per cent of the standard voltage.

MISSOURI

RULE 7. Each utility shall keep a record of the time of starting up and shutting down all important items of equipment. A record shall be kept of the indications of the principal switchboard instruments, station meters, gauges, etc., readings being taken at sufficiently frequent intervals to show the characteristics of the load. (Graphic recording instruments should be used for this purpose in accordance with the best modern practice when feasible.)

These records or charts, suitably identified and dated, shall be filed available for inspection by the commission and preserved for a period of at least two years.

Utilities which do not furnish 24-hour service shall report to the commission any proposed change in their regular operating schedule before the effective date of same.

NEW HAMPSHIRE

RULE 11. Each utility shall keep a record of the time of starting and shutting down power station equipment and feeders, together with the indication of the principal switchboard instruments at sufficiently frequent intervals to show the characteristics of the load; and shall maintain a record of all interruptions of service upon the entire system or major divisions of its system, and include in such record the time, duration, and cause of each interruption.

NEW YORK**Second District**

ORDER OF MAY 13, 1912.—1. That each and every such electrical corporation be and it hereby is required and directed—

(1) To install and hereafter maintain watthour meters so connected that the reading of such meter or meters will record any kilowatt hours of electric energy generated by such corporation;

(2) To install and thereafter maintain watthour meters so connected that the reading of such meter or meters will record in kilowatt hours all electric energy bought by such corporation;

(3) To install and thereafter maintain either indicating or graphic wattmeters so that the load in kilowatts generated at any particular time will be indicated or recorded;

(4) To install and thereafter maintain either indicating or graphic wattmeters so that the load in kilowatts purchased at any particular time will be indicated or recorded;

(5) Permanently record so as to be accessible to this commission the following information: (a) The reading of the watthour meters at the same time daily for each day in the year; (b) at least half-hourly readings of wattmeters during the three consecutive hours of heaviest load each day, and at least hourly readings during the remainder of the day when the station is in operation; (c) the highest daily swing of the wattmeters noticed by the operators in charge, together with the time such swing occurred.

PENNSYLVANIA

No. 3. *Record of Station Voltage*.—Each utility shall keep in continuous operation at least one graphic recording voltmeter in each generating station. Each utility shall also place and connect additional graphic recording voltmeters at such places and for such periods of time as the commission may from time to time require. All records from such meters shall be kept on file as specified in rule 10 (p. 138).

WISCONSIN

RULE 24. Each utility furnishing electric service shall keep a record of the time of starting and shutting down power station equipment and feeders together with the indication of the principal switchboard instruments at sufficiently frequent intervals to show the characteristics of the load, and shall maintain a record of all interruptions of service upon the entire system or major divisions of its systems, and include in such record time, duration, and cause of each interruption.

WEST VIRGINIA

RULE 27. *Station Wattmeters and Watthour Meters*.—Every utility shall install such watthour meters as may be necessary to obtain daily and monthly records of the output of its plant. Every utility purchasing electrical energy shall install such watthour meters as may be necessary to furnish full information as to daily and monthly purchases unless such instruments are installed by the selling company.

RULE 28. *Station Records and Interruptions of Service*.—Every utility shall keep a record of: (1) The time of starting and shutting down power station equipment and feeders; (2) the indication of sufficient switchboard instruments to show the characteristics of the load; and (3) all interruptions of service upon the entire system or major divisions of its system, and include in such record the time, duration, and cause of each interruption.

VOLTAGE SURVEYS**ARIZONA**

RULE 17. Each electric utility shall at frequent and regular periods make measurements of the line voltage at the station; these records to be filed for reference.

Each electric utility shall also install such installations as may be necessary to measure its total station kilowatt-hour output and the records of output shall be preserved for reference.

CONNECTICUT

RULE E-8. *Voltage and Current Surveys and Records*.—(a) Each utility shall provide itself with one or more portable indicating voltmeters, and each utility serving more than 50 customers shall have one or more curve-drawing voltmeters and, if supplying constant current, one or more curve-drawing ammeters, these instruments to be of a type and capacity suited to the voltage and constant current supplied. Each utility shall make voltage surveys with sufficient frequency to indicate the service furnished from each feeder and to satisfy the commission of its compliance with the voltage requirements, and those having curve-drawing voltmeters shall keep at least one of these instruments in continuous service at the plant, office, or some customer's premises. All voltmeter and ammeter records shall be available for at least 15 months for inspection by the commission or anyone authorized by the commission.

MISSOURI

RULE 28. To insure compliance with the requirements specified in rule 27, each utility furnishing electric service shall supply itself with one or more portable indicating voltmeters, suitable for the service voltages furnished, and maintain same in

accurate condition. Where 250 or more consumers are served by any utility it must provide itself with one or more portable graphic recording voltmeters suitable for the service voltages furnished. A sufficient number of voltage surveys must be made by each utility to indicate that service furnished from various transformers and service mains is at all times in compliance with the foregoing requirements. When graphic recording voltmeters are used, each chart or record should cover an interval of at least 24 hours' duration. These records or charts, suitably identified and dated, shall be kept on file available for inspection for a period of at least two years.

NEW HAMPSHIRE

RULE 15. Each utility which in any year shall have sold more than 50,000 kilowatt hours, or have had more than 50 consumers shall provide itself with one or more portable recording or curve-drawing voltmeters, of a type and capacity suited to the voltage supplied, and shall make a sufficient number of voltage tests upon different parts of its system to indicate that the service furnished is in compliance with the voltage requirements. One of these recording voltmeters shall be kept in continuous service at the plant or office, or on some consumer's premises. All voltage records shall be kept open to public inspection at the office of the utility.

OREGON

RULE 26. (a) Every electric utility shall provide itself with one or more portable indicating voltmeters, and each electric utility serving more than 250 customers shall have one or more portable graphic recording voltmeters. Such instruments shall be of a type and capacity suitable to the voltage supplied. Each electric utility shall make a sufficient number of voltage surveys to indicate the service furnished from each feeder, and when ordered by the commission, from any designated transformer, to satisfy the commission of its compliance with the voltage requirements. Utilities having graphic recording voltmeters shall keep at least one of these voltmeters in continuous service at the plant, office, or some customer's premises; and shall indicate on the graphic records the causes of extreme variations in voltage. All voltage records are to be kept open for public inspection.

WISCONSIN

RULE 26. Each utility furnishing electric service shall provide itself with one or more portable indicating voltmeters, and each utility serving more than 250 consumers shall have one or more portable graphic recording voltmeters, these instruments to be of a type and capacity suited to the voltage supplied. Each of the utilities shall make a sufficient number of voltage surveys to indicate the service furnished from each transformer and feeder, and to satisfy the commission of its compliance with the voltage requirements, and those having graphic recording voltmeters shall keep at least one of these voltmeters in continuous service at the plant, office, or some consumer's premises. All voltage records are to be kept open for public inspection.

WEST VIRGINIA

RULE 26. *Voltage and Current Surveys and Records.*—Every utility shall provide itself with one or more portable indicating voltmeters, and every utility serving more than 200 consumers shall have one or more recording (curve-drawing) voltmeters of type and capacity suited to the voltage supplied. Every utility should make a sufficient number of voltage surveys to indicate the service furnished from each center of distribution, and to satisfy the commission of its compliance with the voltage requirements; and those having curve-drawing voltmeters should keep at least one each of these instruments in continuous service at the plant, office, or some consumer's premises. All voltmeter and ammeter records shall be available for inspection by the commission, or anyone authorized by the commission.

VOLTAGE VARIATIONS**CONNECTICUT**

RULE 6. Voltage Variation.—(a) Each utility shall adopt a standard voltage or standard voltages, as may be required, for its constant potential system, or for any subdivision into which the system may be divided, and shall maintain such voltage or voltages constant within reasonable limits. Variations in excess of the following limits may, at the discretion of the commission, and after investigation, be considered as unreasonable, due allowance being made for local conditions.

(1) For service rendered under a lighting contract, or primarily for lighting purposes, between sunset and 11 o'clock p. m., 5 per cent above or 3 per cent below standard voltage for periods longer than one minute in each instance.

(2) For service rendered under a power contract, or primarily for power purposes, 10 per cent above and 10 per cent below standard voltage for periods longer than one minute in each instance, at any time when the service is furnished.

DISTRICT OF COLUMBIA

SECTION 15. Voltage.—On all constant potential systems, electrical corporations shall maintain at the consumer's service cut-out a standard voltage within the following percentages: 3 per cent from the standard during lighting hours and 10 per cent from the standard during other hours on systems primarily for lighting; 10 per cent from the standard on power circuits (trolley circuits excluded).

Variations in voltage of momentary duration which do not occur successively and variations caused by the operation of apparatus on the consumer's premises in violation of the rules of the electrical corporation or due to other causes beyond the control of the corporation shall not be considered a violation of this section.

ILLINOIS

RULE 26. Voltage variation.—Each utility supplying electrical energy from a constant potential system, shall adopt a standard service voltage for each locality supplied from such system, the suitability and adequacy of which voltage may be determined at any time by the commission and every reasonable effort shall be made by the use of proper equipment and operation to maintain such voltage practically constant at all times during which service is supplied. For service rendered under a lighting contract, or primarily for lighting purposes, the variations of voltage as measured at each consumer's cut-out shall not exceed 5 per cent, plus or minus, of the standard service voltage for that locality for a longer period than one minute at each instance at any time during which service is supplied. For service rendered under a power contract, or primarily for power purposes, voltage variations as measured at the service terminals shall not exceed 10 per cent, plus or minus, of the standard service voltage for that locality for a longer period than one minute at each instance.

Variations of voltage in excess of those specified above caused by the operations of the consumer in violation of his contract or the rules of the utility, or from causes beyond the control of the utility, shall not be considered a violation of this rule.

INDIANA

No. 23. Each company supplying electrical energy on constant potential systems shall adopt and maintain a standard average value of voltage as measured at any consumer's cut-out, which shall remain constant from day to day, and varying during any one day by an amount not more than 6 per cent of the minimum value.

MISSOURI

RULE 27. Each utility supplying energy from a constant potential system shall adopt standard service voltages for the entire system or each subdivision thereof, and every reasonable effort shall be made by the use of proper equipment and operation to maintain such voltage practically constant at all times. The suitability and adequacy of these service voltages may be determined at any time by the commission.

For lighting service, the variation in voltage, for periods exceeding one minute, as measured at the consumer's cut-out, shall not exceed 3 per cent above and 5 per cent below standard service voltage for that locality between sunset and 11 p. m. and 5 per cent above and 10 per cent below between 11 p. m. and following sunset.

For power service, the variation in voltage for periods exceeding one minute shall not at any time be greater than 10 per cent above or below standard service voltage for that locality at the consumer's cut-out.

Utilities will not be held responsible for variations in service voltage caused by the operation of apparatus by the consumer in violation of the utility's rules or by the action of the elements, or causes beyond the utility's control.

NOTE.—This rule may be waived for any particular consumer by special written agreement other than the regular service contract or application, provided that such an arrangement does not affect the quality of the service to other consumers.

MONTANA

No. 17. Each company supplying electrical energy on constant potential systems shall adopt and maintain a standard average value of voltage as measured at any consumer's cut-out, which shall remain constant from day to day, and varying during any one day by an amount not more than 6 per cent from the minimum value.

NEVADA

RULE 23. Each company supplying electrical energy on constant potential systems shall adopt and maintain a standard average value of voltage as measured at any consumer's cut-out, which shall remain constant from day to day, and varying during any one day by an amount not more than 6 per cent of the minimum value.

NEW HAMPSHIRE

RULE 14. Each utility which in any year shall have sold more than 50 000 kilowatt hours, or have more than 50 consumers shall adopt a standard voltage for the entire constant potential system (or major divisions thereof approved by the commission), and shall maintain the voltage within 3 per cent below and 5 per cent above, such standard on all lighting circuits during lighting hours, and on power circuits and on lighting circuits during other than lighting hours within 10 per cent of such standard. All other utilities shall maintain their voltage regulation on all constant potential lighting circuits during lighting hours so that the maximum voltage furnished any consumer shall not be more than 10 per cent above the minimum.^{52a}

^{52a} The fluctuations in voltage permitted by this rule may upon first consideration appear to be excessive, but in view of the conditions existing in many parts of the State, a more exacting requirement at this time might work undue hardship upon some of the utilities. A closer regulation may be expected to be practical in the future. It may be that some utilities can not immediately meet the requirements of the rule as now made, since such requirements may involve the redesign and reconstruction of distribution systems, or the installation of regulating devices. In any case application may be made to the commission for a temporary suspension, or a modification of the rule to meet the reasonable requirements of the particular situation, and in such case the commission will make investigation and will take such action as may be in fact reasonably necessary. Momentary fluctuations in voltage resulting from the proper operation of the plant shall not be considered a violation of this rule.

NEW JERSEY

No. 6. Each utility supplying electrical energy on constant potential system shall adopt and maintain an average value of voltage as measured at any customer's cut-out, and the fluctuations as measured by a standardized indicating voltmeter shall not vary between sunset and 11 p. m. for periods exceeding five minutes more than 3 per cent above nor more than 3 per cent below the standard voltage for said location in force at the time; provided, however, that variations in pressure caused by the operation of apparatus on customers' premises in violation of the utility rules, the action of the elements, or other causes beyond the utility's control shall not be considered a violation of this provision.

OREGON

RULE 25. (a) Every electric utility shall adopt a standard voltage for the entire constant potential system in every city served by it having a population of 1500 or more, or, with the approval of the commission, may divide its distributing system in such city into districts and adopt a standard voltage for each such district. Notice of the adoption of such standard voltage shall be given by the utility to the commission. Except as may be caused by the operation of apparatus by the customer in violation of the utility's rules, or by the action of the elements or causes beyond the utility's control, every electric utility shall maintain the voltage constant in every such city so that the same shall not vary for periods exceeding five minutes more than the following amounts:

1. Lighting circuits: Between sunset and 11 p. m. more than 3 per cent above and 5 per cent below the standard voltage for such locality.
2. Lighting circuits: Between 11 p. m. and the following sunset, more than 5 per cent above and 10 per cent below such standard voltage.
3. Other circuits: More than 10 per cent above or below such standard voltage.

(This rule may be waived by the customer by special agreement, separate from his service contract or application, particularly referring to this rule.)

PENNSYLVANIA

No. 2. *Voltage Variation.*—Each utility supplying electrical energy from a constant voltage system shall adopt standard service voltages for such system, the suitability and adequacy of which voltages may be determined at any time by the commission, and every reasonable effort shall be made to maintain such voltage practically constant at all times during which service is supplied. For service rendered under a lighting contract, or primarily for lighting purposes, the variations of voltage as measured at the service terminals shall not exceed 5 per cent plus or minus of the standard service voltage for that locality for a longer period than one minute at each instance, at any time during which service is supplied. For service rendered under a power contract, or primarily for power purposes, voltage variations as measured at the service terminals shall not exceed 10 per cent, plus or minus of the standard service voltage for that locality for a longer period than one minute at each instance:

Provided, first, That this limit of 10 per cent, shall not apply to power supplied from direct current trolley wires; and second, That a utility may if satisfactory to and approved by the commission, furnish service under conditions of greater voltage variations, (a) upon filing with the commission a copy of all existing contracts containing a provision for service with such greater variations of voltage, or, (b) upon filing with the commission a copy of all existing contracts which do not contain a provision for such greater variations in voltage, together with a statement in each case of the variations in voltage existing in the service rendered under each said contract, and (c) upon filing with the commission a copy of all contracts made hereafter which contemplate service under conditions of greater voltage variations, and which

shall in each case henceforth contain a clause stating the probable variations in voltage that will occur in the service rendered under said contract: And provided further That such greater variations in the voltage shall not result in unreasonable discrimination in favor of or against any consumer.

Variations of voltage in excess of those specified above, caused by the operation of the consumer in violation of his contract or the rules of the utility, or for causes beyond the control of the utility, shall not be considered a violation of this rule.

WEST VIRGINIA

RULE 24. Standard Voltage and Permissible Voltage Variation.—Every utility supplying electrical energy shall maintain a standard voltage on their constant potential system and as measured at the consumer's cut out, and under the following conditions:

On circuits primarily for lighting a variation of 5 per cent above and 3 per cent below standard will be permitted, but not to exceed such variation longer than one minute at each instance.

On circuits used for power only or for both lighting and power purposes, a variation of 10 per cent either way from standard will be permitted, but such variation shall not exceed 10 per cent longer than one minute at each instance.

Variations in voltage in excess of those specified, caused by the operation of apparatus on the consumer's premises in violation of the utility's rules, or the action of the elements, shall not be considered a violation of the rule.

WISCONSIN

No. 25. Voltage Variation.—Each electric utility operating in a city having a population of 1,500 or more shall adopt a standard voltage for the entire constant potential system and shall maintain the voltage within 3 per cent of such standard on all lighting circuits during lighting hours; on power circuits and during other than lighting hours the voltage shall be maintained within 10 per cent of the standard. All other electric utilities shall maintain their voltage regulation on all constant potential circuits during lighting hours so that the maximum voltage furnished any consumer shall not be more than 6 per cent above the minimum voltage at that consumer's cut-out.

V. SUGGESTED RULES FOR THE REGULATION OF ELECTRIC SERVICE BY STATE COMMISSIONS

In the adoption of rules for electric service by a number of States, the Bureau has been represented at public hearings or has made written suggestions at the request of the State commission considering the matter. By conference and correspondence with commissions, utility operators, and committees of various engineering and technical associations, much information from many sources has been collected. In order to make this information available to regulating bodies in a concise and definite form, certain rules and regulations are here proposed, embodying the various points discussed in the first sections of this Circular, and setting forth what seems to be the commonly accepted practice in electric utility regulation. The rules of all State commissions owe much to the rules of the Wisconsin Railroad Commission, adopted in 1908 and revised in 1913. The rules here proposed are the result of a very careful study of all existing rules, and of accepted good practice throughout the country.

Certain provisions with reference to electric plant and maintenance are incorporated in the rules here proposed. In Arizona, Connecticut, California, Illinois, Idaho, Nevada, and Oregon special safety and construction rules or recommendations are in force, while in Washington an act has recently been passed providing for certain construction and safety requirements in considerable detail. In other States, labor and industrial commissions are considering rules and regulations with reference to safety standards. In the service rules here proposed a few safety requirements are also included, supplementary to the general provisions common to all commission rules in force.

It should be specially noted that the suggested rules are drawn up to apply generally in all States. Modifications must be made on account of varying provisions of State laws and local practice. The rules here given apply, for example, to municipally owned utilities, but in a number of the States, municipal utilities are not subject to regulation by the commission. Meter accuracy is fixed by law in several States (see Appendix 2, Table 3), the percentage accuracy ranging from 2 per cent to 5 per cent. In other States, the commission fixes the allowable limits.

RULES AND REGULATIONS PRESCRIBING STANDARDS FOR ELECTRIC SERVICE AND PROVIDING FOR THE TESTING OF METERS AND OTHERWISE REGULATING THE SERVICE OF ELECTRIC UTILITIES

Rule 1. Definitions and General Provisions.⁵³—(a) In the interpretation of these rules, the word “commission” shall be taken to mean the Public Service Commission of ———; the word “utility” shall be taken to mean any person, firm, corporation, or municipality engaged in the business of supplying electrical energy to the public; and the word “customer” shall be taken to mean any person, firm, corporation, municipality, or other political subdivision of the State supplied by any such utility.

(b) The adoption of these rules and regulations shall in no way preclude the commission from altering or amending the same in whole or in part, after due notice and public hearing, or from allowing other or requiring additional service, equipment, facility, or standards, either upon complaint or upon its own motion, or upon the application of any utility. These rules shall not in any way relieve any utility from any of its duties under the laws of this State.

(c) Any utility may decline to serve a customer or prospective customer until he has complied with the State and municipal regulations on electric service and the reasonable rules and regulations of the utility furnishing the service.

OPERATION AND MAINTENANCE

Rule 2. Maintenance of Plant, Equipment, and Facilities.—

(a) Each utility shall have and maintain its entire plant and system in such condition as will enable it to furnish safe, adequate, and continuous service within its hours of operation.

(b) Each utility shall file with the commission annually a statement regarding its plant, equipment, and facilities, in such form as the commission may require.

Rule 3. Accepted Good Practice.—The generating and distributing system, including: (a) Generating equipment; (b) Transmission lines; (c) Substations; (d) Overhead system, poles, lines, transformers, etc.; (e) Underground system, manholes, conduits, etc.; (f) Street-lighting system; (g) Service wires and attachments; (h) Meters and instruments; shall be constructed, installed, and maintained in accordance with accepted good practice.

⁵³ The definitions in this rule should correspond to the definitions occurring in the law under which any set of rules may be issued.

Rule 4. Pole Identification.—(a) Each utility shall, on or before ———, mark each pole, post, or other structure used for supporting electrical conductors with (1) the initials of its name, abbreviation of its name, corporate symbol, or other distinguishing mark by which the owner of each such structure may be readily and definitely determined; (2) a number by which the location of each such structure may be described.

(b) The identification marks shall be made with paint, stamps, brands, or other means as the utility may elect to use, and the characters of the mark shall be of such size and so spaced and hereafter maintained as to be easily read by one standing on the ground at a distance of 6 feet from the structure.

(c) In the case of two or more utilities jointly owning any such structure, the distinguishing mark of each utility shall be placed thereon, but not more than one number need necessarily be placed thereon.

(d) In the case of such structures erected upon private rights of way, or on the public highways, when of such character that the construction may be deemed to be a through line, such marks and numbers need be affixed only to every fifth structure.

(e) The requirements herein shall apply to all existing and future erected structures and to all changes in ownership.

(f) Every such utility shall file with the commission in duplicate on or before ——— a statement showing (1) the initials, abbreviation of name, corporate symbol, or distinguishing mark; (2) the means of marking to be employed; (3) the method intended to be followed in numbering structures within the limits of cities, towns, or other built-up communities, and upon through lines.

Rule 5. Pole Inspection.—Each pole, post, tower, or other structure used for the support or attachment of electrical conductors, guys, or lamps must be inspected by the utility owning or using it with sufficient frequency to determine the necessity for replacement or repair.

Rule 6. Grounding of Low-Potential Circuits.—The rules currently in force contained in the National Electrical Safety Code regarding grounding of low-potential circuits shall be followed for all new construction. Each utility shall adopt a plan whereby existing ungrounded circuits will be grounded in conformity with this rule, and submit the same to the commission for approval by ———, 191—.

METERS

Rule 7. Location of Meters.—(a) It is recommended that all meters hereafter installed on customers' premises should be located in the cellar or first floor, or as near as possible to the service, in a clean, dry, safe place, not subject to great variations in temperature and on a support free from vibration. Where it is necessary to install meters out of doors, they should be protected from the weather.

(b) Meters should not be placed in coal or wood bins or on the partitions forming such bins, nor on any unstable partitions or supports. Unless unavoidable, meters should not be installed in attics, sitting rooms, bathrooms, bedrooms, restaurant kitchens, over doors, over windows, or in any location where the visits of the meter reader or tester will cause annoyance to the customer.

(c) Meters should be easily accessible for reading, testing, and making necessary adjustments and repairs. When a number of meters are placed on the same meter board, the distance between centers should not be less than 15 inches, and each meter loop should be so tagged or marked as to indicate the circuit metered. Meters should preferably not be less than 4 feet, nor more than 7 feet, above the floor or a suitable platform.

Rule 8. Meter-Testing Facilities and Equipment.—(a) *Standardizing Laboratory.*—Whenever any utility is maintaining or shall hereafter establish and maintain a standardizing laboratory, periodic inspection by the commission will be made of the instruments and methods in use, and if instruments and methods are acceptable to the commission after such inspections, certification of meters and instruments for its own use and for other utilities may be made by such laboratory.

(b) *Facilities and Equipment.*—Each utility furnishing metered electric service shall, unless specifically excused by the commission, provide for and have available such meter laboratory, standard meters, instruments, and other equipment and facilities as may be necessary to make the tests required by these rules. Such equipment and facilities shall be acceptable to the commission, and shall be available at all reasonable times for the inspection of any authorized representative of the commission.

(c) *Test Standards.*—1. Each utility furnishing metered electric service shall provide for and have available such portable indicating electrical testing instruments or watthour meters of suitable range and type for testing service watthour meters, switch-

board instruments, recording voltmeters, and other electrical instruments in use, as may be deemed necessary and satisfactory by the commission.

2. For testing the accuracy of portable watthour meters, commonly called "rotating standards," and other portable instruments used for testing service meters, each utility, not specifically excused by the commission as provided for in section (b) of this rule, shall provide for and have available as reference or check standards suitable indicating electrical instruments, wattmeters, watthour meters, or any or all of them, hereafter called reference standards. Such standards may be of the service type of watt-hour meters, but if so such watthour meters shall be permanently mounted in the meter laboratory of the utility, and be used for no other purpose than for checking working rotating standards.

Reference standards of all kinds will be tested, and if necessary adjusted, by the commission at least once a year unless a standardizing laboratory is maintained as provided for in (a) of this rule.

3. All portable watthour meters (rotating standards) shall be compared with the reference standards at least once a week for commutator types and once in two weeks for induction types during the time such portable testing standards are being regularly used. Unless accompanied by a calibration card, if such check shows any portable watthour meter (rotating standard) to be in error more than 1 per cent plus or minus at any load at which the standard will be used the meter shall be tested, adjusted, and certified in the laboratory of the utility, or in some other approved laboratory, or by the commission. Each portable watthour meter (rotating standard) shall at all times be accompanied by a certificate or calibration card, signed by the proper authority, giving the date when it was last certified and adjusted. Records of certifications and calibrations shall be kept on file in the office of the utility.

4. All portable indicating electrical testing instruments, such as voltmeters, ammeters, and wattmeters, when in regular use for testing purposes, shall be checked against suitable reference standards at least once a week when continually in use, and if found appreciably in error at zero or more than 1 per cent of full scale value at commonly used scale deflections shall, unless accompanied by calibration card, be adjusted and certified in some approved laboratory or by the commission.

Rule 9. Accuracy Requirements for Service Watthour Meters.—

(a) No watthour meter that has an incorrect register constant, test constant, gear ratio, or dial train, or that registers upon no load ("creeps") shall be placed in service or be allowed to remain in service without adjustment and correction.

(b) No watthour meter that has an error in registration of more than plus 2 or minus 4 per cent at light load or plus or minus 2 per cent at heavy load shall be placed in service. Whenever on installation, periodic, or any other tests a meter is found to exceed these limits it must be adjusted. A meter creeps when, with all load wires disconnected, the moving element makes one complete rotation in five minutes or less.

(c) Light load shall be approximately 5 to 10 per cent of the rated capacity of the meter. Heavy load shall be not less than 60 per cent nor more than 100 per cent of the rated capacity of the meter.

Rule 10. Place and Methods for Meter Testing.—(a) All tests on watthour meters in service provided for in these rules shall be made in the place of permanent location on the customer's premises with approved testing apparatus and under local conditions of operation, unless otherwise stated in any rule or allowed by special order of the commission.

(b) Meters installed with instrument transformers or shunts shall be tested jointly with such transformers or shunts, otherwise the ratio of transformation of the transformers and the resistance of the shunts must have been previously determined within five years and be on file at the office of the utility for use in calculating results of tests made. All such calibration tests must have been made by a laboratory of recognized standing, or by the utility, using apparatus and methods satisfactory to the commission.

(c) Meters that are to be used on circuits of low power factor (lagging current) shall be tested and adjusted before installation to register correctly to within 2 per cent plus or minus at a power factor of approximately 50 per cent, and at approximately 100 per cent of rated current.

Rule 11. Installation Tests.—All watthour meters shall be tested and adjusted to register accurately to within the limits specified in Rule 9 (b) before installation, or within 60 days after installation. Each commutator meter and direct-current meter shall be tested and adjusted within 60 days after installation.

Rule 12. Periodic Tests.—(a) All types of watthour meters installed upon customer's premises shall be periodically tested according to the following schedule:

Schedule for Periodic Testing of Watthour Meters

	Rated capacity of meter in amperes or kilovolt-amperes	To be tested at least once in every—
Direct-current meters.....	Exceeding 500 amperes.....	6 months.
	500 amperes to 15 amperes.....	18 months.
	15 amperes and less.....	24 months.
Alternating-current meters:		
1. Single phase.....	Exceeding 25 amperes.....	24 months.
	25 amperes and less.....	36 months.
2. Polyphase.....	Exceeding 50 kilovolt-amperes.....	12 months.
	50 kilovolt-amperes and less.....	24 months.

(b) All watthour meters in service on and after ———, for which there is on file at the utility's office no record of test made within the period of time specified for that class and rating of meter in (a) above, shall be tested as soon as possible. In no case shall the time subsequent to ——— exceed the period of test for meters of that class and rating as specified in this rule.

Rule 13. Tests upon Request of Customer.—Each utility shall, without charge, make a test of the accuracy of registration of a meter upon the request of a customer, provided that the customer does not request such test more frequently than once in 12 months. A written report, giving results of such test, shall be made to the customer, and a copy of this report and a complete record of such test shall be kept on file at the office of the utility for a period of at least three years.

Rule 14. Tests by Commission.—(a) Upon written application by any customer to the commission a test will be made on the customer's meter by an inspector employed by the commission, such test to be made as soon as practicable after receipt of the application. For such test a fee as scheduled below shall be paid by the customer at the time application is made for the test. The utility owning the meter will be notified that such test is to be made, and should have a representative present to open the meter, assist in the test, and adjust and seal the meter after the test. If the meter is found to be correct or slow, this fee will be retained. If the meter is found to be more than 4 per cent

fast, the amount of the fee will be refunded to the customer and collected from the utility owning the meter.

(b) Upon application to the commission by any utility, the commission will make a test on any of the utility's meters upon payment of the scheduled fee.

Schedule of Fees.

(Suitable schedule of fees to be inserted here.)

Rule 15. Meter Records and Reports.—(a) Each utility furnishing metered service shall keep a record (1) of the names and addresses of all its customers with the utility's serial number of the meter or meters used by each of them and (2) of all its meters, showing dates of installation and removal.

(b) A complete record shall be kept by each utility of all tests of watthour meters installed on customers' premises. Such record shall include: Owning utility's number of meter; manufacturer's name and number of meter; type and capacity of meter; constants of the meter; date and kind of test made; the error (or per cent accuracy) at heavy load and at light load as found at each test, and the accuracy of adjustment as left after each test.

(c) The meter records of each utility shall be available for examination at any time by the commission, its engineers and inspectors. The record of tests of each meter shall be continuous for at least two periodic test periods, and in no case for less than five years.

(d) Each utility shall report to the commission before ——— the types and number of meters in its service, and yearly thereafter. Each utility shall file with the commission such reports of meter tests as the commission may from time to time require.

INFORMATION TO CUSTOMERS

Rule 16. Information as to Reading of Meters.—Each utility supplying metered service shall adopt some method of informing its customers how watthour meters are read, either by printing on bills a description of the method of reading meters, by distributing booklets or folders describing the method, or by notice to the effect that the method will be explained on application.

Rule 17. Information on Bills.—Bills rendered periodically by each utility supplying metered service shall show in addition to the net amount due, the dates on which the readings were taken, the meter readings when requested by the customer and all other essential facts upon which the bill is based.

Rule 18. Incandescent Lighting.—It is recommended (a) that each utility supplying electricity for incandescent lighting should render its customers reasonable assistance in securing incandescent lamps and other appliances best adapted to the service furnished; (b) that lamps furnished by utilities to customers without charge (free renewals), or at prices less than open-market prices, should be of such efficiency in watts per candle, when used on the utility's circuits of standard voltage as defined in rule 22, so that customers may obtain their lighting service under the most favorable conditions practicable under the rate schedule.

Rule 19. Information as to Kinds of Service.—Each utility shall on request of any customer or prospective customer furnish a statement of the kind or kinds of service available, giving the standard voltage, nature of current and, if alternating current, the frequency and number of phases. Where one class of service is available through only a part of the district served, this should be stated in connection with any such application. Where service is available only at certain times of day or night, full information must be readily available to all prospective customers or their representatives.

Rule 20. File of Rate Schedules, Rules and Regulations of the Utility and of the Commission.—(a) Copies of all schedules of rates for service, forms of contracts, charges for service connections and extensions of lines, and of all rules and regulations covering the relations of customers and utility shall be filed by each utility in the office of the commission. Complete schedules, contract forms, rules and regulations, etc., as filed with the commission, shall also be on file in the local office of the utility, and shall be open to the inspection of the public.

(b) It is recommended that a copy of the rules and regulations for electric service as published and furnished by the Public Service Commission should be on file and open to the inspection of the public.

(c) It is recommended that the attention of the public be called to these files of schedules, rules and regulations, by placing a suitable placard in the office of the utility.

VOLTAGE AND FREQUENCY

Rule 21. Standard Voltage and Permissible Voltage Variation.—(a) Each utility shall adopt a standard average voltage or standard average voltages, as may be required by its distribution system for its entire constant-voltage service, or for each of the several

districts into which the systems may be divided, and shall file with the commission a statement as to the standard average voltages adopted. The voltage maintained at the utility's main service terminals shall be reasonably constant, as follows:

1. For service rendered under a lighting contract or primarily for lighting purposes, between sunset and 11 o'clock p. m. the voltage shall be within 5 per cent plus or minus of the standard adopted, and the total variation of voltage from minimum to maximum shall not exceed 6 per cent of the average voltage in cities and other incorporated places having a population in excess of 2500, nor 8 per cent of the average voltage in all other places.

2. For service rendered under a power contract or primarily for power purposes, the voltage variation shall not exceed 10 per cent above or 10 per cent below standard average voltage at any time when the service is furnished.

3. A greater variation of voltage than specified above may be allowed when service is supplied directly from a transmission line, or in a limited or extended area where customers are widely scattered and the business done does not justify close voltage regulation. In such cases the best voltage regulation should be provided that is practicable under the circumstances.

(b) Variation in voltage in excess of those specified, caused (1) by the operation of power apparatus on the customer's premises which necessarily requires large starting currents, (2) by the action of the elements, and (3) infrequent and unavoidable fluctuations of short duration due to station operation, shall not be considered a violation of this rule.

(c) Utilities supplying power to one or more other electric utilities may make application to the commission for a ruling applicable to each case.

Rule 22. Standard Frequency.—Each utility supplying alternating current should adopt a standard frequency, should file with the commission a statement as to the standard adopted and should endeavor to maintain this frequency to within 5 per cent above and 5 per cent below the standard, at all times.

Rule 23. Voltage and Current Surveys and Records.—Each utility should provide itself with one or more portable indicating voltmeters, and each utility serving more than 50 customers should have one or more recording (curve drawing) voltmeters and if supplying constant current one or more recording (curve drawing) ammeters. These instruments should be of a type and

capacity suited to the voltage and constant current supplied. Each utility should make a sufficient number of voltage surveys to indicate the character of the service furnished from each center of distribution, and to satisfy the commission upon request of its compliance with the voltage requirements; and those having curve drawing voltmeters and ammeters should keep at least one each of these instruments in continuous service at the plant, office or some customer's premises. All voltmeter and ammeter records shall be available for inspection by the commission, or anyone authorized by the commission, for a period of at least one year.

RECORDS

Rule 24. Station Instruments and Watthour Meters.—Each utility shall install such curve-drawing wattmeters, indicating instruments, or watthour meters as may be necessary to obtain a daily record of the load and a monthly record of the output of its plants. Each utility purchasing electrical energy shall install such instruments or watthour meters as may be necessary to furnish full information as to the monthly purchases.

Rule 25. Station Records and Interruptions of Service.—Each utility shall keep a record of (1) the time of starting and shutting down power-station equipment and feeders; (2) the indication of sufficient switchboard instruments to show the characteristics of the load; and (3) all interruptions of service upon the entire system or major divisions of its system, and include in such record time, duration, and cause of each interruption.

Rule 26. Record of Complaints as to Service.—Each utility shall keep a record of all complaints received at its office in regard to service, which record shall include the name and address of the customer, the date, nature of complaint, and the remedy. The record shall be available for inspection at any time within six months by duly accredited representatives of the commission.

CHARGES, DEPOSITS, AND REFUNDS

Rule 27. Service Connection Charges and Meter Rentals.—No utility shall make any separate charge for furnishing any regular customer with a service watthour meter except as provided for by minimum charge or customer's service charge. Where additional meters furnished by the utility are to be used as submeters or for the convenience of the customer a charge for such meters may be made in accordance with a schedule approved by the commission. If the reasonableness of any charge, rule, regula-

tion, or practice of any utility with reference to service connections or extensions is challenged, the commission will, upon complaint and investigation, prescribe the proper charge, rule, regulation, or practice, which shall thereafter be followed.

Rule 28. Refunds and Prorated Bills.—(a) Whenever a meter in service is found upon test, made by the utility or the commission at the request of the customer, to be more than 4 per cent in error at any load, additional tests shall be made to determine the average error of the meter.

(b) *Average Error.*—The average error of a meter in tests made by the commission or utility, at the request of the customer, shall be determined by one or the other of the following methods:

Method A: Take one-fifth of the algebraic sum of (1) the error at light load; (2) three times the error at normal^{53a} load; (3) the error at full rated capacity.

Method B: Take one-half the algebraic sum of (1) the error at light load; (2) the error at heavy load.

(c) When a meter is found to have a positive average error—i. e., is fast—in excess of 4 per cent, in tests made at the request of the customer, the company shall refund to the customer an amount equal to the excess charged for the kilowatthours incorrectly metered, for a period equal to one-half of the time elapsed since the last previous test, but not to exceed six months.

(d) When a meter is found to have a negative average error—i. e., is slow—in excess of 4 per cent, in tests made at the request of the customer, the company may make a charge to the customer for the kilowatthours incorrectly metered for a period equal to one-half of the time elapsed since the last previous test, but not to exceed six months. If a meter is found not to register for any period, the company shall estimate and charge for the kilowatt-hours used by averaging the amounts registered over similar periods, preceding or subsequent thereto, or over corresponding periods in previous years.

Rule 29. Deposits.—(a) A utility may require from any customer or prospective customer a cash deposit of an amount not

^{53a} In determining normal load the following percentages of the several classes of full-connected installations may be used:

	Per cent
(a) Residence and apartment lighting.....	25
(b) Elevator service.....	40
(c) Factory lighting, individual drives, churches, offices, stables, and hotels.....	45
(d) Factory shaft drive, theaters, clubs, hallways, entrances, and general store lighting.....	60
(e) Saloons, restaurants, pumps, air compressors, and ice machines.....	70
(f) Sign and window lighting, blowers, moving-picture machines.....	100

less than \$———. ^{53b} Interest thereon at the rate of — per cent per annum, payable upon the return of the deposit or annually upon demand by the customer, shall be paid by the utility to each customer making such deposit, for the time such deposit was held by the utility and the customer was served.

(b) Each utility having on hand deposits from customers or hereafter receiving deposits from customers shall keep records to show: (1) The name of each customer making a deposit; (2) the premises occupied by the customer when making the deposit and each successive premises occupied while deposit is retained by the utility; (3) the amount and date of making the deposit; and (4) a record of each transaction, such as payment of interest, interest credited, etc., concerning such deposit.

(c) Each utility shall issue to every customer from whom a deposit is received a certificate of deposit.

(d) Each utility shall provide reasonable ways and means whereby a depositor who makes application for the return of his deposit or any balance to which he is entitled, but is unable to produce the original certificate of deposit or receipt, may not be deprived of his deposit or balance.

Rule 30. Accidents.—(a) Each utility shall keep a record of and furnish to the commission as soon as possible full reports of all accidents happening in, or about, or in connection with the operation of its plants, stations, property, and equipment wherein any person shall have been killed or seriously injured.

(b) It is expected that all possible care will be exercised by each utility to reduce the life hazard (1) to which employees are subjected in working in stations and substations and on overhead and underground lines, (2) to which the utility's customers may be subjected by the introduction of its wires into the residences of the customers, (3) and to which the general public may be subjected by the presence of overhead wires in the public streets and ways.

Rule 31. Reports to Commission.—Each utility shall make special reports at such time and in such form as the commission may from time to time require.

^{53b} A minimum deposit is \$5 for many utilities; \$2.50 is specified in California and West Virginia rules. Rates of interest vary from 4 to 8 per cent. (See p. 87.)

VI. THE REGULATION OF ELECTRIC SERVICE BY CITY ORDINANCE

Few American cities have regulatory ordinances for electric service. Many have ordinances concerning electric wiring, supplementing more or less the National Electrical Code, but only a very small number regulate electric service.

A circular letter was sent to a large number of city electricians, electrical inspectors, and city clerks, in order to determine in a general way what ordinances are to-day in force in cities in States not having regulation by rules enforced by a State public-service commission. From responses to the letter certain ordinances are here reprinted to show the general character of municipal regulation of electric utilities in large and small cities. It is believed that the list of cities is typical of the ordinances now in force.

LIST OF CITIES

CHARLESTON, S. C.

AN ORDINANCE To provide for the inspection of electric meters.

Be it ordained by the Mayor and Aldermen of Charleston in City Council assembled:

SEC. 1. That any consumer of electric light or power shall have the right to apply to the city electrician for an inspection and test of his meter, upon depositing with the city electrician a fee of twenty five cents, and said electrician shall at once inspect said meter and test it.

In the event of its being more than 4 per cent fast the consumer shall have a right to rebate on his previous month's bill, at twice the price of the excess and the inspection fee. In the event of its being more than 4 per cent slow the company shall be entitled to the price of the extra current thereover consumed. [Sept. 12, 1911.]

AN ORDINANCE To create the office of inspector of gas, water, and electric meters, and to prescribe the duties thereof.

Be it ordained by the Mayor and Aldermen of Charleston in City Council assembled:

SEC. 1. That on the second Tuesday in October 1913 and on the same day in every year thereafter, there shall be nominated and appointed, subject to the confirmation of Council, an inspector of gas, water and electric meters, who shall serve for a term of one year from the date of his confirmation and until his successor shall be appointed and confirmed; provided however that such officer shall hold his office during said term at the will of the Mayor and may be discharged or suspended for any cause. He shall receive an annual salary of fifteen hundred dollars (\$1500) payable monthly.

SEC. 2. It shall be the duty of the meter inspector to make a practical test of every gas meter, water meter, and electric meter in the city of Charleston by passing through said meter respectively a certain volume of gas, water and electricity, and observing if the meter indicates correctly the volume thus passed through it.

SEC. 3. He shall likewise close all fixtures and observe from the meter if there be a leak in which event he shall promptly notify the consumer.

SEC. 4. He shall give preference of inspection to citizens applying to him for his services, in writing, and shall comply with such requests in the priority of receipt, making written reports to such applicants.

SEC. 5. He shall keep a daily record of the meters inspected and the results of his inspection which records shall be accessible to any citizen desiring to inspect them.

SEC. 6. He shall make a weekly report to the Mayor of the work accomplished and the results obtained.

SEC. 7. A gas meter shall be deemed accurate which upon test registers not more than 2 per cent fast nor more than 2 per cent slow, and an electric meter and water meter shall be deemed accurate that registers not more than 4 per cent fast or slow, but any percentage noted is to accordingly control the amount of the preceding months bill and all future bills, computed on such meter.

SEC. 8. In the event that any person, firm, or corporation furnishing gas, water or electricity shall knowingly or wilfully overcharge the city or any consumer for such light, water or power furnished, such person, firm, or corporation shall be subject to a fine of not less than fifty dollars (\$50.00) for each offense.

SEC. 9. That in the event that said inspector shall find that the city or consumer has been undercharged, the city or consumer shall be liable to the payment of the correct charge.

SEC. 10. All ordinances and parts of ordinances inconsistent with this ordinance are hereby repealed. [Oct. 28, 1913.]

CHICAGO, ILL.

ORDINANCE ⁵³⁰ of the City of Chicago concerning inspection of electric meters, passed December 13, 1909.

814a. *Duty to Test Meters.*—It shall be the duty of City Electrician or his duly authorized representative, upon request of any person, firm or corporation to whom electricity shall be supplied (and who shall hereafter be referred to herein as the consumer) by any person, firm or corporation engaged in the business of supplying electricity, to examine and test any meter furnished to such consumer by such person, firm or corporation, and used for the purpose of measuring electricity supplied to such consumer at a pressure of 600 volts or less by such person, firm or corporation. Such inspection to be made substantially in accordance with the following requirements:

Any person, firm or corporation desiring the inspection of any electric meter within the city as provided for in this ordinance, shall accompany the application for such inspection with a fee as hereinafter prescribed which shall be paid to the City Collector, and for which such applicant shall obtain a receipt from the City Collector, showing such payment, which receipt shall describe the location of the electric meter to be inspected and its rated capacity, and shall contain the name of the person, firm or corporation for whose benefit said electric meter was installed. Said receipt when presented to said City Electrician shall be his authority for making the inspection herein provided for.

Before making such inspection or test, the City Electrician shall give notice in writing to the consumer making application therefor, and also to the person, firm or corporation whose meter is about to be inspected, setting forth in such notice the time when and place where such inspection or test of such meter is to be made. Such notices shall be mailed at least forty-eight hours before the time set for the inspection of such meter. The notice sent to the consumer shall be addressed to the premises described in the application for inspection and wherein the meter to be inspected and

⁵³⁰ This ordinance was repealed July 15, 1915. See Appendix 4, p. 247, for the ordinance now (1916) in force in Chicago.

wherein the meter to be inspected is installed. The notice to the person, firm or corporation supplying electricity and whose meter is to be inspected, shall be addressed to the principal office of such person, firm or corporation in the City of Chicago. The inspection of any such meter shall be made by the City Electrician or his duly authorized agent at the place where the meter is installed and in place, and such inspection shall be made in such a manner as to thoroughly test such meter, for the purpose of ascertaining whether it registers correctly under the applicant's usual conditions of use of electricity furnished by the person, firm or corporation whose meter is to be inspected.

814b. *Standard Meters.*—There shall be maintained and kept at all times in the office of the City Electrician, primary standard instruments for the measurement of electro motive force and current for both alternating current and direct current, which instruments shall be accurate to within one-tenth ($\frac{1}{10}$) of one per cent (1%) when compared with the standards of the United States Bureau of Standards, and it shall be the duty of said City Electrician to have all such instruments tested, sealed and certified by the United States Bureau of Standards, at least once every six months. The primary instruments so maintained and kept shall be used as standards for the purpose of checking the working standards used by said City Electrician.

814c. *When Meter Deemed Accurate.*—Any electric meter inspected or tested by said City Electrician under and in accordance with the provisions of this ordinance shall be deemed accurate if it registers not to exceed four per cent (4%) above or below the reading of the working standard. Every meter tested or inspected under or in accordance with the provisions of this ordinance shall be tested for the purpose of ascertaining its accuracy on "light load," "average load," and "full load" of said meter. The term "light load" shall mean a load equivalent to ten per cent (10%) of the rated capacity of the meter; "average load" shall be a load equivalent to any load between forty per cent (40%) and fifty per cent (50%) of the rated capacity of the meter, and "full load" shall be a load equivalent to any load between eighty per cent (80%) and one hundred per cent (100%) of the rated capacity of the meter.

Whenever a meter inspected or tested under and in accordance with the provisions of this ordinance shall be found by the City Electrician to be inaccurate, as herein defined, such meter shall be accurately adjusted by the person, firm or corporation installing or using same, so as to make it accurate within the limits herein defined; and if in the opinion of the City Electrician said meter can not be made accurate within the limits as so defined, then the City Electrician shall have the power to compel the installation of another meter in lieu of the one found to be inaccurate.

814d. *When Meter Deemed Incorrect.*—Whenever any meter shall be inspected or tested under the preceding section a test reading of such meter shall be made at its usual average load, if such load can be determined, and if such load can not be determined, then it shall be tested at its "normal load" as hereinafter fixed. If any such meter shall register to exceed four per cent (4%) above or below the working standard at the usual or "normal load," it shall be deemed incorrect for the purposes of this section.

The following classification, in percentage of rated capacity, shall be used in determining the "normal load" above specified of various meters:

	Per cent
(A) Residence and apartment lighting	25
(B) Elevator service	40
(C) Factories (individual drive), churches and offices	45
(D) Factories (shaft drive), theatres, clubs, entrances, hallways and general store lighting	60
(E) Saloons, restaurants, pumps, air compressors, ice machines and moving picture theatres	70
(F) Sign and window lighting and blowers	100

When a meter is found to be connected to an installation consisting of two or more of the above classes of loads, the "normal load" must be obtained by taking the average of the percentages for the classes so connected. If the result of such test at such usual or normal load shall show any meter to be incorrect as above defined, it shall be presumed that such meter was in the same condition and incorrect to the same degree for a period of not to exceed ninety days prior to the date of such inspection or test.

Nothing herein contained, however, shall be held to preclude either the consumer, or the person, firm or corporation owning, installing or using such meter, from establishing by competent evidence the fact that such meter was or was not incorrect for a longer or shorter period of time than ninety days prior to the date of such last inspection.

Where the result of such inspection shows that the meter so inspected is incorrect, as herein defined, and such incorrectness shall operate to the disadvantage of the consumer by causing to be registered a greater amount of electricity than actually flowed or passed through such meter, in such case such consumer shall be entitled to a rebate from the person, firm or corporation supplying him with electricity through such meter, such rebate to be based upon the assumption that such incorrect registration existed for a period of ninety days prior to the date of said inspection or test; *provided, however,* that if the consumer shall be able to establish the fact that such condition existed for a longer period than said ninety days, or if the person, firm or corporation supplying said consumer shall be able to establish the fact that such condition did not exist for so long a period as said ninety days, then, and in either event, the consumer shall be entitled to a rebate for such period of time as it shall be shown such meter registered a greater amount of electricity than actually passed through the same.

If the result of the inspection of any meter shall show that such meter is incorrect, and that such incorrectness operated to the disadvantage of the person, firm or corporation owning or using same by reason of such meter registering a smaller amount of electricity than actually passed through same, in such case such condition shall be presumed to have existed for a period of not to exceed ninety days prior to the date of such inspection, and such person, firm or corporation shall be entitled to charge the consumer an amount equal to what would have been charged had the meter registered correctly, said amount to be based upon the assumption that said meter registered incorrectly in the same degree for a period of not exceeding ninety days prior to the date of such inspection. *Provided, however,* that if the person, firm or corporation supplying the electricity shall be able to establish the fact that such condition existed for a longer period than said ninety days, or if the consumer shall be able to establish the fact that such condition did not exist for so long a period as said ninety days, then, and in either event, the person, firm or corporation supplying the electricity shall be entitled to charge said consumer for such deficiency during the time that said deficiency shall be shown to have existed.

814e. *By Whom Fee to be Paid.*—If the result of any inspection or tests made under and in accordance with the provisions of this ordinance shall show any meter so inspected to be inaccurate or incorrect, as defined herein, on any test hereinbefore provided, and to be registering a greater amount of electricity than passes through the same, within the limits fixed herein, the amount advanced by the consumer requesting such inspection or tests shall forthwith be returned to him and such inspection or test be made without cost or expense of any kind whatsoever to such consumer; and in such case the fee provided for such inspection or tests shall be charged to and paid by the person, firm or corporation installing or using the meter so found to be inaccurate or incorrect. If the result of such inspection or tests shall show such meter not to be registering a greater amount of electricity than passes through the same, within the limits fixed herein, the expense and cost of such inspection or tests shall be paid out of the fee required to be advanced by the consumer making the application for such inspection, and no part of the fee so advanced shall in such case be returned to

such applicant. The current consumed or used in making such inspection or tests shall not be charged to the account of such consumer.

The inspection and tests herein provided for, to be made by the City Electrician, shall be conclusive upon both the consumer making application for such inspection and tests and the person, firm or corporation furnishing, installing or using such meter.

814f. *Fees*.—The following shall be the fees charged by the City Electrician for the inspection or tests of electric meters operating on circuits of 600 volts or less as provided for by Section 814a hereof, to-wit:

Amperes, Rated Capacity:	Fees
10 or less.....	\$1. 50
Over 10 but not more than 15.....	2. 00
Over 15 but not more than 25.....	2. 50
Over 25 but not more than 50.....	3. 00
And for each additional 25 amperes or fraction thereof.....	. 50

814g. *Records to be Kept*.—Said City Electrician shall keep a register or registers in his office in the City Hall in which he shall record the number and description of each meter inspected by him and the time of such inspection and the condition of meter when inspected, together with all notices sent or given by him and all other proceedings of his office in reference thereto. Such records shall at all times be open to the inspection of the Mayor, any member of the City Council, the head of any department or any citizen of the City of Chicago.

814h. *Monthly and Annual Report*.—Said City Electrician shall immediately after the first of such month prepare and submit to the Comptroller a report of the number of electric meters inspected during the previous month. Said City Electrician shall annually on or before the first day of May in each year report in writing to the City Council the complete transactions of his office during the previous year with such other information as he may deem necessary or the said City Council may require.

SECTION 2. This ordinance shall take effect and be in force from and after January 1st, 1910.

AN ORDINANCE For the purpose of fixing * * * the maximum rates for supplying electricity * * * and for other purposes * * *. [Passed Nov. 26, 1913.]

SEC. 1 [last paragraph]. The voltage on any of said Commonwealth Edison Company's distributing lines from which electricity for lighting purposes is furnished, shall as measured at the consumer's service, not vary more than five per cent (5%) either above or below the normal voltage carried by the circuit upon which the service is rendered: provided, however, that variations due to accidents or load conditions over which said Company has no immediate control, shall not be considered a violation of this provision until said company shall have had notice in writing from a consumer affected and thirty (30) days time in which to correct such conditions.

CINCINNATI, OHIO

The superintendent of street lighting department writes as follows:

1. The allowable error of electric meters is 5 per cent.
2. There is no regulation of variations in voltage.
3. No survey of voltage is made by any municipal engineer.
4. Meters are tested by this department upon complaint of the consumer, who makes a deposit of from \$1.50 to \$5, depending upon the size. If in the event that the meter runs faster than 5 per cent fast, the consumer's deposit is returned and the

company makes a rebate proportionate to the amount in excess of 5 per cent. If in the event that the meter registers less than 5 per cent fast, the money is turned into the city treasury.

5. The company makes tests periodically if in their judgement a meter is not proving accurate, and only on their own initiative.

6. There is a provision in the city's street lighting contract which provides that graphic recording ammeters be connected to each lighting circuit, same to be under the direct supervision of this department. These have not been installed to date.

7. There are no public inspectors, the police reporting the "outages," and a deduction is made based on the number of hours burning time per annum, namely, 3,914 hours. [Apr. 7, 1914.]

GRAND RAPIDS, MICH.

The board of public works writes as follows:

We have no allowable standard of error in meters, but have by mutual agreement established a figure of 2 per cent fast or slow.

The board of public works have provided themselves with portable test standards in order to test consumer's meters who make application to them.

Street arc lighting is done by municipal plant and a repair and testing man is employed yearly. [May 12, 1914.]

HARRISBURG, PA.

[File of Common Council No. 31: Session of 1912-13]

AN ORDINANCE TO amend section eleven of an ordinance entitled "An Ordinance giving permission to The Paxtang Electric Company of Harrisburg, etc."

(d) That such person, firm or corporation as may acquire the Paxtang Electric Company in manner aforesaid, will agree to so arrange its transmission and distribution system and so operate the generating equipment, that, on and after eighteen (18) months after such person, firm or corporation shall have acquired the Paxtang Electric Company, the voltage of any standard distributing line over which electricity for lighting purposes is furnished within the city of Harrisburg, shall as measured at the terminals of the company's service lines, not vary more than five (5) per cent, either above or below the normal voltage carried by the current upon which the service is rendered.

In order to keep records of the voltage variation in different parts of the city, the said person, firm or corporation will provide, install and connect at its own expense, at such points as the city electrician may direct, five (5) recording volt meters of some standard manufacture, enclosed in lock boxes or closets, the keys whereof shall be delivered to and remain in the hands of the said electrician. It shall be the duty of said city electrician to change the record paper at proper intervals and maintain the ink supply, at the cost of the city.

The records of such volt meters shall be kept in the office of the City Electrician for at least ninety (90) days and shall at all reasonable times be subject to inspection by such person, firm or corporation aforesaid, or its duly authorized agents, who shall also have the right to make photographic or other copies thereof, and such person, firm or corporation, or its duly authorized agent, shall likewise be given access for inspection purposes, to said volt meters, in the presence of the City Electrician or a representative by him authorized.

Such person, firm or corporation so acquiring the Paxtang Electric Company, as aforesaid, shall pay to the city of Harrisburg for each breach of the provisions of this paragraph of this ordinance, not corrected with due diligence after receipt of written notice from the city electrician that the voltage has varied beyond the limits herein specified for three (3) consecutive days, at any point within the city of Harrisburg

and that such excess variation has continued for periods of more than ten (10) consecutive minutes on each of said days, the sum of one hundred dollars (\$100) for each such default extending over the period of three (3) consecutive days.

Provided, however, That no claims or suit to recover the penalty herein provided shall be enforceable unless such claim be made or suit be brought within ninety (90) days of the time when such breach is alleged to have occurred.

The voltage variation herein and hereby prohibited shall not be construed to include temporary variations resulting from incidental, unusual or abnormal load conditions over which such person, firm or corporation may have no immediate control, nor to voltage variations which may exist at the time of accidents to machinery, devices or transmission lines, and such person, firm or corporation may by publication of notice of any such accident in any local newspaper of the happening thereof, relieve itself from the operation of the above prescribed penalty, but this shall not relieve such person, firm or corporation from the exercise of due diligence in making needed repairs or additions to overcome the effects of any such accident or accidents or such load conditions.

Approved May 29, 1912.

KANSAS CITY, MO.

AN ORDINANCE Creating the office of inspector of electric meters, providing for an assistant inspector, and fixing the salaries thereof, providing for the establishment of a city laboratory and for the purchase of instruments therefor, prescribing the duties of said office and the methods and manner of testing electrical instruments, fixing a license tax upon electric meters, and repealing other ordinances.

Be it ordained by the Common Council of Kansas City:

SECTION 1. For the purpose of enforcing the ordinances of this city relating to the manufacture, distribution and measurement of electrical current, and for the purpose of providing a method by which electric meters may be fairly and accurately tested, there is hereby created the office of inspector of electric meters.

SEC. 2. The said inspector shall be appointed by the Mayor, and shall hold his office subject to Article XV of the charter of Kansas City, Mo., relating to Civil Service, and shall be paid a salary of Eighteen Hundred Dollars (\$1800) per year, and said inspector, subject to the terms of said article relating to Civil Service, shall appoint an assistant inspector at a salary of twelve hundred dollars (\$1200) per year; both such salaries shall be paid as the salaries of other officers of the city are paid.

The said inspector shall be an expert in theory and practice in the use of electrical measuring instruments, apparatus and appliances, and in the installation of electric wires and matters pertaining thereto; and he shall have had prior to his appointment five (5) years practical experience in such work; he shall give bond in the penal sum of five thousand dollars (\$5000) with two or more sufficient sureties to be approved by the City Comptroller, conditioned upon the skillful, faithful, and impartial performance of the duties of his office.

The assistant inspector shall have the same qualifications as the inspector except only that it shall not be required that said assistant shall have had five (5) years practical experience in said work.

SEC. 3. The City Purchasing Agent shall, upon requisition from said inspector, subject to the provisions of the charter, purchase and deliver to said inspector at a cost of not to exceed twenty-five hundred dollars (\$2500) electrical measuring instruments to consist of the most accurate and standard fixed and portable instruments ordinarily used for the purpose of testing the accuracy of electric meters.

The City Comptroller shall furnish said inspector proper space in the City Hall for such laboratory and said inspector shall install therein said instruments. Said inspector shall have sole custody and control over said instruments, and shall place such safeguard thereabouts as to insure that the accuracy thereof will not be inter-

ferred with in any manner whatsoever; shall from time to time take all steps necessary or expedient to insure that said instruments are remaining standard and shall from time to time make proper tests to insure their accuracy and for that purpose may have the same tested at the laboratory of the State University in this and other states having equipment for that purpose, but shall not expend for last named purpose more than the sum of two hundred dollars (\$200) per year without special ordinances of the city.

SEC. 4. Said inspector and assistant inspector shall perform their duties under the supervision of the Public Utilities Commission, which commission shall make public rules and regulations not inconsistent with the terms of this ordinance subject to which said duties shall be performed. Said inspector shall have his office with the clerk of the Utilities Commission; said clerk shall receive complaints of the public and requests for the inspection of meters, refer them to said inspector, and shall see that complete and accurate records are kept of complaints, inspections, the results thereof and other matters properly pertaining thereto.

SEC. 5. It shall be the duty of every person, firm or corporation setting meters, to list same within ten (10) days after installation and notify the electrical meter inspector of all such installation and furnish him with a copy of such test within forty-eight (48) hours after such installation, and the electrical meter inspector, whenever he deems it necessary, in any case, inspect any meter without waiting for a complaint from any one.

SEC. 6. If any consumer of electricity furnished by any seller thereof to the public, shall make application to the clerk of the Public Utilities Commission, or to said inspector, for a test of the meter through which the same is furnished, and shall accompany such application with a fee of seventy-five (75) cents, such inspector, together with such assistant, shall proceed as soon as may be, to make a test of the accuracy of said meter, make and sign original notes of such test and file and preserve the same in his office. Said inspector shall also forthwith, in writing, inform both the consumer and the furnisher of electricity, of the result of said test.

SEC. 7. Any meter not in excess of two and one-half per cent fast, or two and one-half per cent slow, on an average load, shall be deemed commercially correct. If the meter is found upon completion of the test, to be more than two and one-half fast or two and one-half per cent slow, the said inspector shall then and there recalibrate and leave the same operating accurately and approved by said inspector, or if the meter be broken, or if for any other reason it is not practicable to recalibrate the same, then the inspector shall order said meter removed and a new meter put in its place, The owner of the meter furnishing the current, shall have the right to have a representative present at each and every test and recalibration; such representative, shall be permitted to be present throughout the same and to take notes thereof.

SEC. 8. If the meter shall be found to be over two and one-half per cent fast, the seller of the current shall within fifteen (15) days after notification of such fact by said inspector refund to the consumer, an amount equal to the percentage the same is found to be fast on the bills the consumer has paid for current, from the day said meter was recalibrated or removed back to two preceding months regular readings, such period not to exceed ninety (90) days, or be less than sixty (60) days, and in the event the meter has not been installed for over ninety days, the period for adjustment shall date from the day said meter was set. Such refund shall be paid to the consumer at the address given by the consumer on his contract. If the same is not paid to the consumer within thirty (30) days after such notice by the inspector, the seller shall then be liable to the consumer for twice the amount of such refund, and the consumer shall have the right to withhold further payments from the company until this double amount is made good. If, however, the consumer is indebted to the seller of current, at the time such refund is due the consumer, the seller may deduct from the refund, such amount and credit the consumer therewith.

SEC. 9. If the meter tested shall be found to be over two and one-half per cent slow the consumer of the current shall within fifteen (15) days after notification of such fact by said inspector, pay to the seller an amount equal to the percentage the same is found to be slow on the bills the consumer has paid for current, from the day such meter was recalibrated or removed, back to two preceding months regular readings, such period not to exceed ninety days, or be less than 60 days, and in the event of the meter has not been installed for over ninety days, the period for adjustment shall date from date said meter was set. If said amount is not paid by the consumer within thirty (30) days after the test the company is authorized to remove the meter and disconnect service from said consumer, and shall not be required to reconnect service until all old accounts are settled, and under such circumstances shall be permitted to make a charge of \$5.00 before resetting another meter for said consumer to reimburse said company for the cost of removing the first meter, and resetting the second.

SEC. 10. In case of a stopped meter, and the inspector being so notified either by consumer or company, the inspector shall order that a new meter be installed and the average current consumed per day, in the ten days succeeding the installation of said meter as shown by this new meter, shall be taken as a basis of settlement for the time it is known the meter has been stopped, or if the time is not known, such time, not to exceed thirty (30) days, as in the judgment of the inspector is in fairness to both parties.

SEC. 11. In case it is found at any time by the company that a meter on the premises of a consumer has been tampered with, or purposely made inaccurate, or that the meter seal has been tampered with or broken, or wires attached to the meter in order to make inaccurate readings or any wires so run as to divert current so that it does not pass through the meter, the inspector and city electrician shall be so notified and upon their finding any of the above conditions, shall then authorize the company to remove said meter and all service from said consumer, and the seller of current may, thereafter, refuse to furnish service to the person served through this meter at the place where the meter was installed or any other place.

SEC. 12. Every person, firm, association, or corporation furnishing electrical current to the public for hire, and employing electrical meters for measurement of the same, shall pay to the city for the privilege of using such meters a license fee of twenty cents per year for each and every meter so used, which sum, shall be paid in advance on the first day of November of each year; and the number of meters upon which said license shall be paid, shall be those in use on the first day of November of each year; and those subject to said license shall on the first day of November of each year; furnish to the city a sworn statement of the number of meters in use at that date.

SEC. 13. Any person practicing or attempting to practice any frauds upon any seller of electricity, subject to the terms of this ordinance, by tapping or connecting to the feed wires of such seller and obtaining current without a meter, and any person, firm or association or corporation who will wilfully refuse to comply with any of the provisions of this ordinance or the spirit thereof, and any person, firm, association, or corporation furnishing electricity to the public for hire who or which shall permit any electricity meters by which said current is measured, to become or remain more than two and one half percent fast, or violate any other provision of this ordinance, shall be deemed guilty of a misdemeanor, and of a violation of this ordinance, and upon conviction thereof, shall be punished by a fine of not less than five dollars (\$5.00) or more than one hundred (\$100) for each violation of this ordinance.

SEC. 14. In addition to the above duties, said inspector shall from time to time test the accuracy of the standard testing instruments of every person, firm, association or corporation, engaged in selling electrical current to the public for hire, and for that purpose shall have access at all reasonable hours to the laboratories and standardizing instruments of those so furnishing such current for the purpose of checking and testing

the accuracy of the instruments used by them in testing meters of the various consumers.

SEC. 15. Section 119 to section 135, both inclusive of the revised ordinances of Kansas City are hereby repealed.

SEC. 16. All ordinances, or parts of ordinances in conflict with this ordinance, are insofar as they so conflict, hereby repealed.

Approved October 12, 1910.

LOS ANGELES, CAL.

[Ordinance No. 22334 (new series)]

The Mayor and Council of the city of Los Angeles do ordain as follows:

SEC. 3. Every electric lamp used or supplied to any customer by any person, firm or corporation engaged in the business of supplying electric light or electric current for lighting purposes to the city of Los Angeles or its inhabitants for use with the current so supplied shall be plainly marked with the voltage at which it is intended to be used, and with the candlepower of the light given thereby, at said voltage; and the voltage of electric current supplied by any such person, firm or corporation to any customer for use in the lamps so furnished, shall not be more than three per cent greater or less than the voltage for which said lamp is marked; and every such person, firm or corporation shall plainly mark the main or conductor through which any electric current furnished by such person, firm or corporation for lighting purposes, is delivered by affixing thereto at the point where such main or conductor is attached to the premises of the consumer of such current a tag or label, bearing in plain figures the voltage at that point of the current supplied by such main or conductor.

SEC. 4. Every meter furnished or installed by any person, firm or corporation engaged in the business of supplying electric light or electric current for lighting purposes or electricity for heating or power purposes to the city of Los Angeles or to its inhabitants shall be plainly marked on the outside and on the front thereof with the current capacity of such meter, in amperes and shall also be plainly marked with the meter constant, that is to say, with the factor by which the reading of said meter must be multiplied in order to ascertain the amount of energy registered thereby.

SEC. 5. It shall be unlawful for any person, firm or corporation engaged in the business of supplying electric current for lighting purposes to the city of Los Angeles or its inhabitants to furnish or supply to any customer for use in any lamp furnished or supplied by such person, firm or corporation, for use with such current any electric current which is more than three per cent greater or less, in voltage, than the voltage marked upon such lamp, unless such excess or deficiency of voltage could not have been prevented by the exercise of ordinary care or prudence on the part of such person, firm or corporation, or for any such person, firm or corporation to fail, neglect or refuse to mark in the manner prescribed in section 3 hereof, any lamp furnished or supplied by such person, firm or corporation, to any customer for use with the current supplied by such person, firm or corporation, or to fail, neglect or refuse to mark in the manner prescribed in section 4 hereof, any meter furnished or installed by such person, firm or corporation, or to fail, neglect or refuse to mark in the manner prescribed in section 3 hereof, the main or conductor through which electric current is furnished; or for any such person, firm or corporation, or for any agent of any such person, firm or corporation, knowingly to charge or collect from any person, firm or corporation for a greater quantity of electric current than has been actually furnished.

SEC. 6. It shall be the duty of the Board of Public Utilities to cause to be made an examination and test of the accuracy, capacity and condition of any electric meter in the city of Los Angeles, installed and used for the purpose of measuring electric current furnished to the city of Los Angeles, or to any person, firm, association or corporation therein for lighting, heating or power purposes, by means of wires or other

conductors, suspended or laid along across or in the streets of said city; and to test and measure the voltage of any electric current so furnished at the point where the main or conductor carrying such current is attached to the premises in which said current is used. Such examination, test and measurement shall be made upon the written request of the person, firm, association or corporation, receiving and using for lighting, heating or power purposes the electric current measured through the meter to be tested. After the making of such examination, test and measurement said Board shall cause a certificate, in writing, showing the results thereof, to be delivered to the person, firm, association or corporation at whose request the examination, test or measurement is made, and shall deliver to the person, firm, association or corporation furnishing the electric current through said main and measured by said meter, a duplicate of such certificate. Said certificate shall show the time and place of the examination, the number and make of the meter examined, its capacity in amperes, the percentage and character of error, if any, in the measurement made thereby, and the voltage of the electric current supplied through the said main or conductor at the point where the same is attached to the premises of the consumer. The Board of Public Utilities shall, and is hereby authorized and empowered to charge and collect a fee of one dollar for making each and every such examination, test and measurement, payable at the time the written request for the making thereof is received by it, and said Board shall cause to be paid into the City Treasury of said city, on every business day, all fees collected by it during the preceding business day, for the making of said tests. All moneys so collected and paid into the City Treasury by said Board shall be placed to the credit of the fund of the Department of Public Utilities.

Approved April 25, 1911.

LOUISVILLE, KY.

[No. 214, series 1914]

AN ORDINANCE⁶⁴ Providing for the appointment of an inspector of gas and electricity and prescribing his duties and compensation.

Be it ordained by the General Council of the City of Louisville:

SECTION 1. *Appointment of Inspector.*—That the Mayor of the City of Louisville at the beginning of his term as Mayor is hereby authorized and empowered to appoint, subject to the approval of the Board of Aldermen, a competent person as inspector of gas and electricity who is qualified and recommended to the Mayor as hereinafter provided.

The inspector, his deputies or his clerk shall not be pecuniarily interested either directly or indirectly in the manufacture or sale of gas or electricity, meters, or any article or commodity used by gas or electric light companies, or used for any purpose connected with the consumption of gas or electricity.

The inspector, his deputies or his clerk shall not give certificates or written opinions to the maker or vendor of any such article or commodity.

The Board of Public Works and the City Engineer shall constitute a board for the examination of all persons who shall apply for the position of inspector. Said board shall give public notice of the time and place of such examination by insertion in the daily papers or otherwise as said board may direct. At the time and place so fixed the board shall examine all applicants in such manner as it shall deem necessary to determine their technical knowledge and competency to perform all duties of inspector as called for in this ordinance. Said board shall within two weeks after such examination certify to the Mayor the names of such persons as said board shall deem fully competent to make the tests required in this ordinance. Only persons whose names are so certified shall be eligible to be appointed inspector. Provided, however, that any person who shall previously have held the office of inspector under this ordinance

⁶⁴ Sections relating entirely to Gas Service are here omitted.

may be reappointed to said office without such certificate from the board; provided also that a person who has once been certified as competent by said board shall be subsequently eligible for appointment without again being examined thereby during a period of four years from such first examination.

SEC. 2. *Term of Office of Inspector.*—Before entering upon the duties of said office said inspector shall take the oath of office such as required by other city officials and shall give bond, to be approved by the Mayor and General Council, in the sum of Five Thousand (\$5,000) Dollars for the faithful performance of his duties.

He shall receive a salary at the rate of Three Thousand (\$3,000) Dollars per annum, payable monthly in like manner as the salaries of other city officers and employees.

He shall serve for a term of four years, but said inspector may be removed by the Mayor at any time upon written notice to that effect giving his reasons for such action.

SEC. 3. *Deputies and Clerk.*—The inspector, with the consent and approval of the Mayor, may appoint not more than two deputy inspectors. Each of said deputies shall be competent to perform any and all tests herein provided for which he shall be required or directed to make. Said deputies so appointed shall have the power under the direction of the inspector to perform any duty which may be required of the inspector under the provisions of this ordinance.

The inspector, with the consent and approval of the Mayor, may also appoint an assistant or clerk, who need not necessarily be competent to make the tests herein provided for, but who shall under his direction aid in the performance of the duties of this office. Said deputies and clerk shall take the oath of office such as is regularly required of other city officials, and shall give bond in the sum of Two Thousand Five Hundred (\$2,500) Dollars for the faithful performance of their duties. Said deputies and clerk shall hold office for a term of four years, but shall be removable at any time at the pleasure of the Mayor.

Each of said deputy inspectors shall receive a salary at the rate of One Thousand Five Hundred (\$1,500) Dollars per annum, payable monthly. The clerk shall receive a salary of One Thousand Two Hundred (\$1,200) Dollars per annum, payable monthly.

SEC. 4. *Duties of Inspector.*—(1) The inspector shall test or determine as hereinafter prescribed the quality and pressure of all gas and the voltage of electricity furnished by any gas or electric company operating in the City of Louisville and the accuracy of gas and electric meters. He shall have full charge and control of all testing stations, laboratories and offices provided for his use for such testing and for the keeping of records.

(2) He shall examine and, subject to the action of the Board of Public Works, approve all rates filed with the Board of Public Works or charged by any gas or electric company.

(3) He shall receive and investigate complaints regarding the quality of the gas, gas pressure, electric voltage and the accuracy of gas and electric meters, and when so requested shall promptly report the result of said investigation to the party complaining and to the company involved.

(4) He shall keep at his office a record of all tests and calculations and formal complaints, which shall be preserved complete and correct, including all tests of gas quality and pressure, of electric voltage and of all gas and electric meters examined.

(5) He shall make a monthly report of the tests made as to candle power, heating value, impurities and pressure of gas, and the electric voltage and the tests made of gas and electric meters. One copy of said report shall be sent to the company concerned, one to the Board of Public Works of the City of Louisville and the whole report, or an abstract of said report, may be published by the Board of Public Works in the official papers of the City of Louisville. The inspector shall also render to the Board of Public Works each month a statement of the amount due to the city or to the consumers from any gas or electric company for penalties or fees required under this ordinance or the franchises of said gas or electric companies.

(6) The inspector shall make a special report to the Mayor, and to the Board of Public Works, whenever the quality or pressure of the gas or voltage of electricity shall be shown by tests not to conform to the requirements of this ordinance or the franchises of the gas and electric companies. The substance of said special report shall be communicated to the company by the inspector immediately upon the delivery of same to the Mayor after completion of the test which showed such condition to exist.

(7) He shall perform any and all other duties naturally connected with this office as required or implied by any part of this ordinance, or any existing or future franchise, or as specially assigned to him at any time by the Mayor or the General Council.

SEC. 5. *Testing Stations.*—(1) As soon as practicable after the passage of this ordinance the city shall provide and maintain testing stations and shall equip and maintain the same with such apparatus and supplies as may be needed for carrying out the provisions of this ordinance. One of said stations shall be located at the City Hall and others may be established at or near centers of gas consumption, and if possible shall not be less than one mile, nor more than two miles, measured in a direct line, from any manufacturing plant of the company or companies furnishing gas in the City of Louisville. The company or companies shall run special service pipes for gas and wiring for electricity into each of said testing stations, the same to be of such size and installed in such manner as may be directed by the inspector; provided that the company or companies shall be allowed to so protect these service pipes for gas as to prevent their exposure to temperature lower than those of the gas-supplying mains.

(2) (Omitted.)

(3) One of said testing stations shall be equipped by the city with approved standard electricity meters and other necessary appliances and apparatus which the inspector may require for the testing of electricity meters, voltage regulation, and in general carrying out the provisions of this ordinance.

SEC. 6. *Method of Testing.*—The methods of testing the quality and pressure of said gas and the voltage of electricity and the accuracy of gas and electric meters shall be those set forth in the latest circular of the National Bureau of Standards of the Department of Commerce, or according to the best practice.

SEC. 7. *Gas Meters and Gas-Meter Testing.*—(Omitted.)

SEC. 8. *Electric Meters and Electric Meter Testing.*—(1) The company shall have available suitable working standards for the testing of electric service meters, and shall maintain these standards correct within one-half of 1 per cent., or apply the proper corrections to all tests made with them. Each standard shall at all times be accompanied by a certificate giving the date it was last checked, the correction to be applied at various loads, and signed by the proper authority. These certificates, when superseded, shall be kept on file in the company's office, and be kept open to inspection by the inspector at any time.

(2) Every electric service meter shall within thirty days after being installed by the company on any consumer's premises be checked by the owning company for correct electrical connections, mechanical condition, proper and suitable location, and accuracy of adjustment and registration at approximately one-tenth and three-fourths of the rated capacity of the meter, commonly called light load and heavy load. All meters so checked and found in error in excess of 1 per cent, in comparison with approved suitable standards shall be adjusted to register correctly to within 1 per cent. at both light and heavy load.

(3) All electric service meters installed upon consumers' premises shall be periodically tested, and if found in error more than 1 per cent. at light load or heavy load be adjusted to register within 1 per cent. by the owning company in accordance with the following schedule:

(a) *Direct Current Meters.*—Meters of rated capacity up to and including 25 amperes shall be tested at least once in eighteen months.

Meters of rated capacity exceeding 25 amperes up to and including 500 amperes shall be tested at least once in every twelve months.

Meters of rated capacity exceeding 500 amperes shall be tested at least once in six months.

(b) *Alternating Current Meters.*—Single-phase meters of rated capacity up to and including 25 amperes shall be tested at least once in every thirty months.

Single-phase meters of rated capacity exceeding 25 amperes shall be tested at least once in every twenty-four months.

Poly-phase meters of rated capacity up to and including 150 amperes shall be tested at least once in every twenty-four months.

Poly-phase meters of rated capacity exceeding 150 amperes shall be tested at least once every twelve months.

(4) The company shall, after the passage of this ordinance, take such steps as may be approved by the inspector to test all its meters according to the schedules herein set forth. All tests made at time of installation and all periodic tests of electric meters shall be subject to such supervision by the inspector as he may deem necessary to insure that provisions of this ordinance are complied with.

(5) Upon formal application by any consumer to the inspector a test shall be made of the consumer's electric service meter by the inspector, such test to be made as soon as practicable after receipt of application. For such test a fee of fifty cents shall be paid by the consumer at the time the application is made for the test; this fee to be retained if the meter is found to be slow or incorrect within 4 per cent. as averaged at light load and heavy load. If the meter is found to be more than 4 per cent. fast as averaged at light load and heavy load the company shall pay to the consumer the fee of fifty cents, and further the company shall refund to the complaining consumer such a percentage of the amount of the bills for the previous three months, or for the time the meter was in service, not exceeding three months, as the meter was found to be in error at the time of the test.

If the meter is found to be more than 4 per cent. slow, as averaged at light load and heavy load, the company may charge to the complaining consumer such percentage of the amount of the bills for the previous three months, or for the time the meter was in service, not exceeding three months, as the meter was found to be in error at the time of the test.

(6) The company owning any meter on which the inspector is about to make a test upon consumer's complaint shall be notified by the inspector that such test is to be made, and should have a representative present to open the meter, and if necessary to adjust the meter to within the required limits of 1 per cent. at light load and heavy load, and to seal the meter after completion of test and adjustment.

(7) The installation, removal, installation and periodic tests and adjustments, and transportation of meters, shall be at the expense of the company owning the meters.

SEC. 9. *Gas Pressure.*—(Omitted.)

SEC. 10. *Variation of Voltage and Voltage Surveys.*—(1) The company shall adopt a standard voltage for its entire constant potential system, or for each of the several districts into which the system may be divided, and shall maintain such a voltage, as measured at any consumer's cut-out by a standardized indicating voltmeter, so that variations of more than 3 per cent. above or 3 per cent. below such standard voltage shall not occur between sunset and 11 o'clock p. m. for periods exceeding five minutes on lighting circuits. On other than exclusively lighting circuits variations of more than 10 per cent. above or 10 per cent. below the standard voltage shall not occur at any time for periods exceeding five minutes; provided, however, that variations in voltage caused by the operation of apparatus on the consumer's premises, in violation of the company's rules, the action of the elements, or other causes beyond the company's control, shall not be considered a violation of this section.

(2) The company shall provide itself with one or more portable indicating voltmeters and one or more graphic recording voltmeters, these instruments to be of a type and capacity suited to the voltage supply.

The company shall make a sufficient number of voltage surveys to indicate the service furnished from each feeder and to satisfy the inspector of its compliance with the voltage requirements, and shall keep one or more graphic recording voltmeters in continuous service at its plant, office or some consumer's premises. All voltmeter records shall be kept open for public inspection.

SEC. 11. *Quality of Natural Gas.*—(Omitted.)

SEC. 12. *Records of the Company.*—The company shall maintain complete and correct records as prescribed hereinafter and shall allow free access to said records at all reasonable hours to the inspector, deputy inspector, clerk or other city official who may be authorized by the General Council to have such privilege. The records shall include the following:

(1) Record of all consumers purchasing gas or electricity from the company and the number of the meter or meters in use by each.

(2) Records of all the meters owned by the company, with the date of their purchase, and a record of the use, tests and repairs to which each has been subjected, with the result of each testing, and the location of each meter.

(3) Record of all complaints made to the company regarding (a) the quality of gas, (b) the pressure of the gas, (c) the voltage of electricity, and (d) the accuracy of meters, both gas and electric, and the record of the method of disposal of each of said complaints.

(4) Record, with the necessary maps and charts, of all gas mains, gas service pipes, governors and other connections or appliances owned and used by the company in the distribution of gas, and all mains, cables, wires, etc., used in the distribution of electricity.

SEC. 13. *Complaints.*—The company shall make a reasonable investigation of all complaints made to it by the inspector or by any consumer, and shall promptly make all such changes, alterations or additions to its methods or apparatus and equipment as may be necessary in order that the quality and pressure of the gas and the furnishing of electric current shall be such as is required by the provisions of this ordinance and any existing franchise for furnishing gas and electricity in the City of Louisville. When requested by any complainant the company shall inform said complainant as to the results of the investigation of his complaint, stating the cause of the difficulty and the approximate time when it will be corrected.

SEC. 14. *Penalties.*—The company shall be subject to and shall pay to the City of Louisville upon conviction a penalty of the amounts set forth below whenever and as often as it shall violate the respective provisions of this ordinance, it being understood that the penalties herein enumerated are not to waive or in any way lessen the rights of the consumers of the City of Louisville or the City of Louisville as fixed in the ordinances and franchises granted to such offending companies or persons.

(1) to (7) (Omitted.)

(8) In case that any gas or electric meter is installed or allowed to remain in service without test, contrary to the provisions of this ordinance without the written permission of the inspector for such installation or for the omission of such test, a fine of \$50 for each meter so installed or so left without test.

(9) In case that any person, firm or corporation, or any employe of any person, firm or corporation engaged in furnishing gas or electricity to consumers shall misread any meter in favor of any corporation, firm or individual furnishing said article, or shall falsely report the reading of any meter, a fine of not less than \$50 nor more than \$100 for each offence.

(10) In case that any person, firm or corporation engaged in the manufacture or distribution of gas or electricity in the City of Louisville shall fail or refuse to prepare, maintain or disclose such records as they are required to do by the provisions of this ordinance, such person, firm or corporation, its managing officers and agents shall be deemed guilty of a misdemeanor and upon conviction thereof shall be punished by a

fine of not less than \$15 nor more than \$100, and each day that any person, firm or corporation shall fail to comply with the provisions in reference to the records of said company shall be deemed a separate offense.

(11) In case that the company shall fail to make a reasonable investigation of all complaints made to it by the inspector herein, or by any consumer, or to promptly make all changes, alterations or additions to its methods or apparatus and equipment as may be necessary hereunder, or shall fail to carry out the provisions of Section 13 hereof, a fine of not less than \$50 nor more than \$100, and each day's failure or refusal to conform to the provisions of said section after notice in writing by the inspector shall be deemed a separate offense.

(12) In case that any company furnishing electricity in the City of Louisville shall fail or refuse to maintain the voltage required herein, a fine of not less than \$50 nor more than \$100 for each day, and each day of said failure or refusal to maintain said voltage after notice from the inspector herein shall constitute a separate offense.

SEC. 15. If any person, firm or corporation violates any provisions of this ordinance for which a penalty is not specifically provided for herein, said person, firm or corporation shall be deemed guilty of a misdemeanor and upon conviction thereof shall be fined not less than \$10 nor more than \$100, and each day's continuance of said violation after notice in writing by the inspector herein shall constitute a separate offense.

SEC. 16. The word "company" as used in this ordinance shall be construed to include any person, firm or corporation engaged in the manufacture and distribution of gas or electricity, or both, as the case may be, in the City of Louisville or to its citizens for compensation.

SEC. 17. Nothing in this ordinance shall be deemed or construed to be a waiver by the City of Louisville of any provision in any franchise in its favor or in the favor of any consumer of gas or electricity.

SEC. 18. The ordinance entitled "An Ordinance providing for the appointment of a city gas inspector and prescribing his duties and compensation," approved April 7, 1908, is hereby repealed.

SEC. 19. This ordinance shall take effect from and after its passage.

Approved June 3, 1914.

MEMPHIS, TENN.

SEC. 13. *Be it further ordained:* That any person desiring to have an electric current meter or meters inspected shall notify the Interior Electrical Inspector, and make a deposit with him of \$3.00 for each meter desired to be inspected. Said inspector shall thereupon inspect said meter, or have it inspected, and shall report in writing to the person requesting said inspection the condition of the meter. If said meter is not more than 3 per cent fast, the said Interior Electrical Inspector shall deduct from the sum deposited with him the sum of one dollar for each meter examined, and the expense of said examination, if any of said meters were disconnected, and pay the balance to the party requesting said inspection. If said meter or meters are more than 3 per cent fast, then the Electric Light Company furnishing said meter or meters shall pay the fees for examining any such meters as are more than 3 per cent fast, and the extra deposit made by the party desiring such inspection shall be refunded to him. Said Interior Electrical Inspector shall embody in his monthly and annual reports a statement of the meters examined, and the conditions thereof, and shall pay all fees thus collected weekly to the City Clerk.

SEC. 14. *Be it further ordained,* That the Board of Commissioners shall annually, upon the nomination of the Commissioner of Public Utilities, Grounds and Buildings, elect an Interior Electrical Inspector and an Assistant Interior Electrical Inspector, who shall be electricians of at least five year's experience on interior wiring and qualified under the state laws. They shall give bond in the sum of \$2000.00 each

to faithfully perform their duties, and their salaries shall be such sums not to exceed \$1500.00 each, as shall be determined by the Board of Commissioners before their election.

Approved Feb. 11, 1910.

MINNEAPOLIS, MINN.

AN ORDINANCE Relating to the inspection and testing of electric meters in the city of Minneapolis.

The City Council of the city of Minneapolis do ordain as follows:

SEC. 1. It shall be the duty of the inspector of gas of the city of Minneapolis, when requested, to inspect, examine and test any and all meters used in the city of Minneapolis for measuring and ascertaining the quantity of electricity or electric energy or power furnished by any person, persons, company or corporation to users and consumers of electricity or electric energy or power in the City of Minneapolis. Such examination and test of electric meters shall be made by said inspector of gas with standard measuring instruments and apparatus to be furnished by the City Council.

SEC. 2. Any user or consumer of electricity or electric energy or power within the city shall have the right, upon paying to said inspector of gas a fee of fifty cents for each meter, to have his electric meter or meters inspected and tested by said inspector of gas; but the person, company or corporation furnishing any electricity or electric energy or power to such user or consumer thereof shall have due notice of the time and place where such examination and test is to be made. A meter shall be deemed to be correct if it appears from such examination and test that it does not vary more than two and one-half per cent fast or slow from the quantity actually used as indicated by said standard measuring instruments and apparatus.

If upon such examination and test a meter is found to be correct, said inspector of gas shall seal or mark the same with some suitable device, but if upon such examination and test it appears that the meter does not register correctly, said inspector of gas shall order the person, company or corporation furnishing such meter to remove the same and to substitute therefor a correct meter.

SEC. 3. If upon such examination and test, at the request of the user and consumer of electricity, a meter is found to be incorrect because too fast and registering more than two and one-half per cent in excess of the quantity actually used, as indicated by said standard measuring instruments and apparatus, said fee of fifty cents paid for such examination and test shall be refunded to the person paying the same, and such inspection fee of fifty cents shall be paid to said inspector of gas by the person, company or corporation furnishing electricity or electric energy or power to such user and consumer thereof. All moneys received by said inspector of gas as fees for examination and test of electric meters under this ordinance shall be paid by him into the city treasury daily.

SEC. 4. This ordinance shall take effect and be in force from and after January 1st, 1907.

Approved August 1, 1906.

NORFOLK, VA.

AN ORDINANCE Providing for the inspection of gas meters and electric meters.

Be it ordained by the Council of the City of Norfolk, Virginia, as follows:

SEC. 1. That in addition to the present duties of the Superintendent of Electrical Affairs (City Electrician) and without extra compensation therefor, he shall, under the direction and control of the Board of Control, make accurate and impartial inspections and tests of gas meters and electric meters in the city of Norfolk.

SEC. 2. No corporation or person shall furnish or put in use any gas meter which shall not have been inspected, proved and sealed, or any electric meter which shall not have been inspected, approved, stamped or marked by said superintendent of

electrical affairs, for which service the corporation owning such meters shall pay into the City Treasury the sum of 25 cents for each meter so inspected.

SEC. 3. Every gas and electric corporation furnishing gas or electricity for use in the city of Norfolk shall provide and keep in and upon its premises a suitable and proper apparatus, to be approved and stamped or marked by the Board of Control for testing and proving the accuracy of gas and electric meters furnished by it for use, and by which apparatus every meter may and shall be tested, on the written request of the consumer to whom the same shall be furnished, and in his presence, if he desires it, as hereinafter provided.

SEC. 4. Whenever request for the inspection and test of any gas or electric meter shall be made to the Board of Control by or on behalf of the person on whose premises the meter is installed, and such person shall have paid into the City Treasury a fee of \$1.00 therefor, the said Superintendent of Electrical Affairs shall be required to make an immediate inspection and test of such meter and to report the result thereof to the said Board. Should such meter be shown by such test to be correct within 4 per cent if an electric meter and to be correct within 2 per cent if an electric-gas meter, then and in that event the meter shall be considered as standard and the \$1.00 so paid shall remain in the city treasury and the consumer shall bear the expense of said test. If, however, said test shall show the meter to be more than 4 per cent fast, if an electric meter, or 2 per cent fast, if a gas meter, which percentage of error will be registering against and to the prejudice of the consumer, the Superintendent of Electrical Affairs shall order the gas or electrical corporation forthwith to remove the same and to place instead thereof a correct meter, approved by said Superintendent as provided in Section 2, and the deposit of \$1.00 shall be returned to the person requesting the inspection and test, and said inspection fee shall be paid into the City Treasury by the corporation owning said meter; should the meter be registering more than 4 per cent slow, if an electric meter, or 2 per cent slow if a gas meter, then, in that event the fee of \$1.00 shall be borne by the parties requesting the inspection.

SEC. 5. All bills against the corporations owning gas or electric meters for inspection fees shall be reported to the Board of Control, who shall cause warrants for collection to be made out against said corporations for said amounts.

SEC. 6. Any person, firm, or corporation who shall violate any provision of this ordinance or fail to comply with any order of the said Superintendent to remove a defective meter and place instead thereof a correct meter, as provided for in section 4 of this ordinance shall pay a fine of not less than \$1.00 and not more than \$10.00 for each offense, and each day's continuance of such violation or failure to comply shall be deemed a separate offense.

SEC. 7. This ordinance shall be in force from and after its passage and due publication, and all ordinance in conflict herewith are hereby repealed.

Approved March 19, 1913. In effect, March 29, 1913.

PROVIDENCE, R. I.

It is ordained by the City Council of the City of Providence as follows:

SEC. 13. Said engineer is hereby empowered to make and from time to time shall make examinations and tests to determine, and shall determine the quality, pressure, voltage and character of the product furnished in the city by public service companies supplying currents of electricity or gas for light, heat, or power.

Chap. 533. No. 281. Approved July 24, 1912.

In the "Providence Power Contract, etc.; also Franchise Agreement between City of Providence and the Narragansett Electric Lighting Co.," Article V, section 1, provides:

Except under abnormal or unusual conditions the electricity sold by either party to the other under this agreement shall not vary in frequency more than five (5) per cent above or below 60 cycles, and the voltage of such electricity shall not vary more than five (5) per cent above or below eleven thousand (11000) volts.

SANDUSKY, OHIO

SEC. 2. All metered services shall be supplied with meters of a high grade, of a quality equal to those manufactured by the Westinghouse Elec. & Mfg. Co., or the General Electric Co. All meters shall be sealed by the Company, and in order that the City Meter Inspector, or anyone acting in that capacity by authority of the City, shall be able to inspect or test any of said meters, the Company, shall at any time, upon direction of the Director of Public Service, remove such particular seals as may be necessary for such purpose. In case it is necessary to remove the meter for purpose of such inspection or test, the said Company shall substitute other meters immediately, so as to avoid interruption of service. Written notice shall be filed daily by the Company in the office of the Director of Public Service or other similar office of the City, of all meters disconnected or removed, with a statement of the reasons for such disconnection or removal. The Company shall not remove from service any meter, when notified so not to do so by the Director of Public Service, or anyone acting in that capacity by authority of the city, and shall not disturb such meter until said notice is duly cancelled by the Director of Public Service. But in any event, the inspection and test of meters so held, on notice by the Director of Public Service, shall be completed by him or his representative within 15 days from date of such notice, after which date, unless previously cancelled, the Company shall have the right to deal with such meters as in the case of ordinary business. All meters must be accurate through the entire range of their load within 3 per cent.

If a consumer believes a meter that has been inspected and tested in the regular course of inspection by the City, to be incorrect, he may again have the same tested upon making written application accompanied with a deposit fee of 50 cents to the Director of Public Service or other officer of the city acting in that capacity; whereupon, after notice to the company his meter shall be again tested and inspected, and if the meter is found to be correct, the consumer shall forfeit his 50 cents deposited to the city. If the meter is found to be incorrect, that is, recording too high, the said company shall pay to the consumer the amount of said deposit and rebate to the consumer the amount of excess charges due to the high record for a period not exceeding two (2) months to said complaint.

In case of a disagreement between the City Meter Inspector, or anyone acting in that capacity, by authority of the city, and the said company relative to the accuracy of testing instruments and tests, either party may demand that the meter or testing instruments be sent to a testing laboratory of established reputation for checking and the party in error shall pay the expenses thereof.

SEC. 3. All electricity furnished shall be of a voltage sufficiently uniform so that there shall be no notice of variation in the light given by an incandescent light and shall be furnished for lighting at either 110 or 220 volts, at the option of the consumer, and for other electric service at such voltage as may be consistent with the apparatus to be used, and to the service of the company, and shall be supplied at a frequency of 60 cycles per second.

SEC. 4. The meters shall be read each month upon such date or dates, covering similar periods, as the Company may elect, and the bills of service, based on the results of said readings, may be issued thereafter as soon as practical. Said bills shall show the date of reading the meter, and shall be payable at the office of the Company on or before ten days from the date of issue.

The city reserves the right to verify meter readings made by the company for the purpose of determining the amounts of bills for current furnished by making any such meter readings in the presence of the City Meter Inspector or any other person or persons acting for and by authority of the city.

SEC. 5. The said company shall be required to furnish a suitable badge to its meter readers, meter inspectors and all employees who are required to enter any building in which the company has electric installations, and shall cause such meter inspectors,

meter readers or other employees to prominently display said badge and furnish other reasonable and proper credentials before entering any buildings, if requested to do so by the owner or occupant thereof.

Approved: 1914.

SAN FRANCISCO, CAL.

ORDINANCE No. 1832 deals with the testing of gas and electric consumer's meters, and requires that such instruments shall be accurate within 2 per cent. In case meter is found to register to the prejudice of consumer the owning company is required to refund upon the basis of meter registration during the three months next preceding the test. Testing is done by an inspector of the City Light and Water Inspection Bureau, and ordinance permits a representative of the owning company to be present during test. I regret I am unable to send you a copy of this ordinance, it being out of print.

[Light and Water Inspector, May 8, 1914.]

SIoux CITY, IOWA

AN ORDINANCE Authorizing the City Engineer of Sioux City, Iowa, to inspect and test electric meters in the city of Sioux City, Iowa, and inspect the arc lamps and lights in the city, providing for the refunding of overcharges to consumers and prescribing for the violation of this ordinance.

Be it ordained by the city council of the city of Sioux City, Iowa.

SECTION 1. It shall be the duty of the city engineer, and such assistants as he may appoint, with the consent of the City Council, when requested, to inspect, examine and test, any and all meters used in the City of Sioux City for measuring and ascertaining the quantity of electricity, or electric energy, or power, furnished by any person, persons, company, or corporation, to users and consumers of electricity, or electric energy, or power, in the city of Sioux City. Such examinations and tests of electric meters shall be made by said city engineer with standard measuring instruments and apparatus.

SEC. 2. Any user or consumer of electricity, or electric energy, or power, within the city shall have the right upon paying to said engineer a fee of fifty cents for each meter, to have his electric meter or meters inspected by said engineer, but the person, company, or corporation, furnishing any electricity, or electric energy, or power, to such user or consumer thereof, shall have due notice of the time and place where such examination is to be made. A meter shall be deemed to be correct if it appears from such examination and test that it does not vary more than two (2) per cent, fast or slow, from the quantity actually used as indicated by said standard measuring instruments and apparatus.

If upon such examination and test, a meter is found to be correct, said engineer shall seal or mark the same with some suitable device, but if upon such examination and test it appears that the meter does not register correctly, said engineer shall order the person, company, or corporation, furnishing such meter, to remove the same and substitute therefor a correct meter.

SEC. 3. If upon such examination and test, at the request of the user and consumer of electricity, a meter is found to be incorrect because too fast, and registering more than two (2) per cent in excess of the quantity actually used, as indicated by said standard measuring instruments and apparatus, said fee of fifty cents paid for such examination and test, shall be refunded to the person paying the same, and such inspection fee of fifty cents shall be paid to the city engineer by the person, firm, company, or corporation, furnishing electricity or electric power, or energy, to such user and consumer thereof. All moneys received by the city engineer as fees for examination and test of electric meters under this ordinance, shall be paid by him into the city treasury daily.

SEC. 4. It shall be the duty of all persons, firms, corporations, or individuals, to furnish meters that measure correctly, and if upon such examination and test of a

meter, it appears the meter of any consumer does not register correctly, because too fast, and registering more than two (2) per cent in excess of the quantity actually used as indicated by the standard measuring instruments and apparatus, any consumer having been theretofore charged, and having paid for electricity as measured by such meter, shall be entitled to, and shall receive pro rate discount on all his electric bills therefor. The percentage and amount of such discount shall be ascertained on the basis of the total number of months the meter was used by consumer, not exceeding six (6) months, and shall be deducted from the next month's bill, or paid to the consumer in cash. Any refusal or neglect to refund by such persons, firms, corporations, or individuals, shall be a violation of this ordinance.

SEC. 5. All persons, firms, corporations, or individuals, furnishing electric lights in the city of Sioux City, Iowa, shall be required to keep the arc lamp globes clean, free from dirt, or other substance that in any way obstructs the light, and replace broken lamps.

Any failure to do so, for a period of twenty-four hours, shall be a violation of this ordinance.

If shall be the duty of the city engineer, on receiving information, or from inspection, that the persons, firms, corporations, or individuals, have failed to comply with this provision, to enter complaint in the proper court and prosecute the said parties for such failure.

SEC. 6. All persons, firms, corporations, or individuals, furnishing or selling electricity for light or power, may request the city engineer to test and seal, or mark, any meter, and upon being tendered or paid the fee of fifty cents, it shall be the duty of the city engineer or his assistants, to test the meter or meters in the presence of a representative of such persons, firms, corporations, or individuals, at such hour as may be arranged, and if the meter does not vary more than two (2) per cent from standard measurement, the engineer shall seal, or mark the meter, and affix a card stating the facts and date of such examination and if found more than two (2) per cent variation, the meter shall not be used again until regulated to record correctly.

SEC. 7. No person other than the city engineer, or his assistants, shall unseal or break the seal of any meter sealed by him, or his assistants, or deface, alter or remove any certificate or card attached to the meter by said engineer or assistant, or place thereon any card purporting to be the certificate of the city engineer.

SEC. 8. All persons, firms, corporations, or individuals, furnishing or selling, electricity for light and power within the city of Sioux City, Iowa, in violation of this ordinance or any provisions thereof, shall on conviction, pay a fine of not less than ten dollars (\$10.00), nor more than one hundred dollars (\$100.00), and shall be imprisoned until such fine be paid, not exceeding thirty (30) days.

SEC. 9. All ordinances and parts of ordinances conflicting with any provisions of this ordinance are hereby repealed.

SEC. 10. This ordinance shall take effect and be in force from and after its passage and publication as provided by law.

Passed February 18, 1911.

ST. LOUIS, MO.

[Ordinance 23864]

SEC. 3C [4th paragraph]. *Electric service of highest quality required.—To furnish incandescent lamps without charge.—To replace burned out fuses.*—The grantee shall furnish to all customers electric service of the highest quality and equal in all respects to that of any company engaged in the city of St. Louis in a similar business, and the nature and voltage of the current delivered shall be such as to operate in the most efficient manner incandescent lamps of the highest efficiency, and all other forms of lamps in commercial use in the United States; and the grantee shall furnish to customers such incandescent and other lamps and shall replace, renew and maintain

the same from time to time, as may be necessary to deliver first class service, without extra charge. The cost of such lamps and their replacement, renewals and maintenance shall be included in the price per kilowatt hour for current. The grantee shall maintain on duty, at all times, a sufficient number of skilled men to promptly remedy and shall therewith promptly remedy, interruptions of service, and the grantee shall replace defective or burned out fuses, which shall be done without extra charge to consumers, and shall be included in the kilowatt hour price for current, as hereinbefore provided. Nothing contained in this paragraph (c) shall be construed as requiring the grantee to maintain the customers inside wiring. Should the customers service be interrupted by reason of faults in wiring which is the customers property, then, in that event, the grantee may charge the customer a reasonable price for making the necessary repairs, providing the customer elects to have the grantee do the work for him.

Not to require guarantee of consumer.—Connection service without charge.—The grantee shall not require any customer to guarantee any sum for service, nor exact any rental for service connection or meters, nor in any manner require any customer to guarantee the use of any fixed amount of current in any period of time, nor require any customer to make a deposit in excess of one average month's bill, upon which deposit the grantee shall allow interest to the customer at five per cent per annum. The grantee shall furnish to each customer applying for service, free of charge, a service connection which shall extend from the grantee's street service mains to the inside of the wall of the customers premises at a point convenient for connection to the grantee's street mains.

Approved October 19, 1908.

TOPEKA, KANS.

[Ordinance No. 2756]

AN ORDINANCE Creating the office of inspector of meters, etc. (prescribing the duties thereof, and providing for the inspection and testing of all electric, steam heat, gas, and water meters used within the city of Topeka, regulating the use of the same and establishing a fee to be paid for the inspection thereof.)

Be it ordained by the Mayor and Councilmen of the city of Topeka:

Inspector of meters created. 1.—There is hereby created the office of inspector of meters of the city of Topeka, and from and after the passage and taking effect of this ordinance the inspector of plumbing of the city of Topeka shall, by virtue of his office, be inspector of meters for the city of Topeka, and he shall, in addition to the duties already enjoined upon him as inspector of plumbing, do, and perform all the duties of the office of meter inspector as hereinafter provided.

Duties. 2.—It shall be the duty of the inspector of meters of the city of Topeka to inspect, test and correctly adjust all meters used within the city of Topeka, for the measurement of electric current, steam heat, gas and water; and said meter inspector shall promptly, at the expense of said city, equip and maintain a testing room for the correct inspection and testing of all such meters as he is called on to inspect or test, in the manner hereinafter provided.

Test of Meters; fee. 3. —Upon the application of any consumer of electric current, steam heat, gas or water for a test of any meter through which electric current, steam heat, gas or water is supplied to him, said consumer shall deposit with said meter inspector one dollar, and take his receipt therefor. Whereupon said meter inspector shall inspect, and if necessary, remove said meter to the testing room of said city. It shall be the duty of said meter inspector to test and correctly adjust, seal, and replace any meter so removed, within three hours after its receipt at said city testing room. Should the meter inspector find any such meter slow or not to exceed three per cent fast he shall pay to the city treasurer the one dollar deposited by the consumer, as aforesaid, and take the city treasurer's receipt therefor; but, should he find the meter incorrect in excess of three per cent fast, the meter inspector shall return said money

to the consumer and take its receipt therefor, and the meter inspector shall collect from the owner of any electric, steam heat, or gas meter the sum of one dollar, pay the same into the city treasury, and take a receipt therefor.

The person, company or corporation furnishing service through any meter of which any such test is to be made shall be given due notice in writing, of the time and place of making such test, and such party shall have the privilege of being present in person or by a representative when the test is made.

Meters; repaired; replaced. 4.—If any meter thus tested cannot be adjusted by the meter inspector, it shall be returned to the owner and repaired or replaced by a correct meter.

Bills; adjustment. 5.—If any electric, steam heat, gas or water meter is found on test to be fast or slow in excess of three per cent, the bill for service for the preceding thirty days shall be adjusted by adding to or subtracting from such bill the percentage, fast or slow as the case may be, and the difference thus determined shall be paid to the consumer by the party furnishing service, or to the party furnishing service, by the consumer, as the case may be.

Meter reading charts. 6.—It shall be the duty of the meter inspector to prepare meter reading charts, showing the meter dial face, with a sample meter reading thereon, and a full explanation of the process of arriving at the amount of the customer's bill, together with such other instructions as will enable the consumer to read his own meter.

Testing instruments; test of. 7.—All testing instruments used by the meter inspector shall be tested and made to conform to the standard measurements at least once a month, or as often as may be necessary to secure accurate and reliable tests.

The meter inspector shall keep on file in his office a record of all tests made.

Take effect. 8.—This ordinance shall take effect and be in force from and after its publication in the official city paper.

VII. SUGGESTED ORDINANCES FOR THE REGULATION OF ELECTRIC SERVICE IN TOWNS AND CITIES

The Bureau has been able to comply with requests from a number of cities for information with reference to the regulation of electric and gas utilities, and has given such information and assisted in the framing of regulatory ordinances.

Such ordinances must be framed so as to meet local conditions and be in harmony with existing franchises. Nevertheless the requirements for safe and adequate service are much the same everywhere in cities and towns of comparable size, and it is hence possible to frame a model city ordinance which, with such modifications as local conditions may require, would be applicable in a great many different places.

It seems desirable to propose a model ordinance in three forms; one applicable to villages and towns, one applicable to cities generally, and one applicable more particularly to the largest cities. In many cities the testing and inspection of meters and service can not in general be done by the municipal authorities on account of the expense involved, while in others such inspection, testing and supervision by a municipal officer is practicable and usual. This is the fundamental difference in the suggested ordinances, the one for small cities and towns simply suggesting what should be aimed at by the utility as to standards of service.

Towns and cities in States having public-service commissions with wide regulatory powers need no such ordinances, the jurisdiction and authority of the commission being in most instances ample to regulate gas and electric service. In many States, however, no commission regulation has been provided for, or the matter has not yet been considered by the existing commission, and for such towns and cities the proposed ordinances may be of interest and value.

In this connection attention may be called to certain interesting differences in the jurisdiction of State commissions with reference to the regulation of gas and electric service in cities. In the State of California—

Any city or county, or incorporated city or town, may retain its powers of control vested therein respecting any one or more classes of public utilities and may thereafter

surrender such powers to the railroad commission of the State of California, hereinafter called the railroad commission, or may reinvest itself with such powers as it may have surrendered to the railroad commission, all as in this act provided.⁵⁵

In Kansas the public-utilities act provides that—

Every municipal council or commission shall have the power and authority, subject to any law in force at the time, to contract with any public utility or common carrier, situated and operated wholly or principally within any city or principally operated for the benefit of such city or its people, by ordinance or resolution, duly considered and regularly adopted: (1) As to the quality and character of each kind of product or service to be furnished or rendered by any public utility or common carrier.⁵⁶

Upon complaint by any public utility or by 10 or more taxpayers to the commission with reference to such ordinance or resolution within 15 days of its publication the public-utilities commission—

May inquire into the allegations in such complaint, and may subpoena witnesses and take testimony to ascertain the truth of the allegations * * *; and if said commission shall find that any provision of any such ordinance or resolution is unreasonable or against the public welfare or public interest, or has reason to believe that the same may be contrary to law, said public-utilities commission shall, within 10 days, advise and recommend such changes in the ordinance or resolution as may be necessary to meet the objections set forth in the complaint and protect the public interest * * *.⁵⁷

In most other States the jurisdiction of commissions covers all utilities throughout the State, and including municipally owned utilities in Idaho, Indiana, Maryland, Massachusetts, Montana, New Jersey, Vermont, West Virginia, and Wisconsin.

The three ordinances suggested follow in order, (1) applicable to towns and small cities, (2) to cities generally, and (3) to the largest cities.

1. FOR TOWNS AND SMALL CITIES

AN ORDINANCE Prescribing rules and regulations for electric service in the city of ——— and prescribing penalties.

The mayor and council do ordain as follows:

Section 1. Adequate Plant Equipment.—Each company furnishing electrical energy for light, heat, or power in the city of ——— shall have and maintain its plant, equipment, and facilities in such condition as will enable it to furnish safe, adequate, and continuous service to its customers within its hours of operation.

Sec. 2. Meter Equipment.—(a) Each company furnishing metered electric service shall install and maintain its meters on regular customer's premises free of charge except as provided for by a minimum charge or customer's service charge.

⁵⁵ Sec. 1, Hewitt election act, statutes of 1911, extra session. Approved Jan. 2, 1912.

⁵⁶ Laws of 1911, chap. 238, sec. 33.

⁵⁷ Loc. cit.

(b) No watthour meter shall be placed in service which "creeps"—that is, registers on no load—or which has incorrect constants or is in any way mechanically defective. All meters either before, or within 60 days after, installation shall be tested and adjusted so as to register correctly to within plus 2 or minus 4 per cent and to within 2 per cent plus or minus at approximately one-tenth and three-quarters respectively of the rated capacity of the meter. A meter creeps when with all load wires disconnected the moving element makes one complete rotation in five minutes or less.

(c) Each company shall have available standard portable watthour meter or meters of types and capacities suited to testing its service meters and at least one portable indicating voltmeter and one curve-drawing voltmeter of suitable capacities. The curve-drawing voltmeter should be kept in service on the company's lines continuously.

Sec. 3. Tests of Meters.—Each company shall test all of its service watthour meters on customer's premises at least once every 24 months, if direct-current meters, and once every 36 months, if alternating-current meters. After test each meter shall be adjusted to register correctly as specified in section 2 hereof.

Sec. 4. Continuity of Service and Voltage Regulation.—Each company shall make every reasonable effort to maintain continuous and uninterrupted service during its service hours and to maintain a constant voltage on its service lines as closely as possible. The maximum voltage variation from the established standard voltage as measured at the company's service terminals should not exceed 5 per cent above or 5 per cent below such standard voltage during lighting hours, and the total variation of voltage from minimum to maximum should not exceed 8 per cent of the average voltage.

Sec. 5. Bills to Customers.—Bills rendered to customers periodically for electric service shall show the readings of the meter at the beginning and end of the interval for which the bill is rendered, the dates on which the readings were taken, and all the other essential facts upon which the bill is based.

Sec. 6. Complaints.—Each company shall make an investigation of all reasonable complaints made to it by its customers and shall upon request, without charge, test customers' meters for accuracy of registration provided such requests are not made oftener than once a year.

Sec. 7. Records.—Each company shall keep a record of all its customers and the meter or meters installed on each customer's premises. A record of all meters shall also be kept which shall show the results of tests on each meter for at least five years.

Sec. 8. Penalties.—Each company shall be subject to and shall pay to the city of ———, upon conviction, a penalty of ——— dollars whenever and as often as it shall violate any provision of this ordinance, it being understood that the penalty herein fixed does not waive or in any way lessen the rights of the customers in the city of ———, or of the city of ———, as fixed in ordinances and franchise granted to the company.

2. FOR CITIES GENERALLY

AN ORDINANCE Prescribing rules and regulations for electric service ⁵⁸ in the city of ——— and prescribing penalties for violations of such rules and regulations.

The mayor and city council of ——— do ordain as follows:

Sec. 1. Electric Plant Maintenance.—The company furnishing electrical energy for light, heat, and power in the city of ——— shall maintain its entire electric plant equipment and distribution system in such condition as will enable it to furnish safe, adequate, and continuous service within its hours of operation.

Sec. 2. Grounding of Low-Potential Circuits.—The rules contained in the National Electrical Safety Code ^{58a} regarding grounding of low-potential circuits are hereby adopted as the standard for this city, and all new construction shall hereafter conform thereto.

Sec. 3. Testing Facilities.—(a) The company shall provide for and have available such testing apparatus and equipment as may be necessary to comply with the terms of this ordinance. It shall have available standard portable watthour meters (rotating standards), indicating electrical instruments, and portable recording voltmeters, of types and capacities suitable for testing service watthour meters, and making voltage measurements on its distribution system.

(b) The company shall provide for and have available suitable electrical measuring instruments and meters to be used as reference standards for testing and maintaining the accuracy of its portable testing meters and instruments. ⁵⁹

⁵⁸ A single ordinance for both gas and electric utilities may be desirable in the smaller cities having both utilities. (See B. S. Circulars 32 and 48.)

^{58a} These rules are contained in Bureau of Standards Circular No. 54, which may be obtained upon application to the Bureau of Standards, Washington, D. C.

⁵⁹ See p. 196 for a more elaborate provision of an ordinance on this point.

Sec. 4. Deposits from Customers.—The company may require from any customer a cash deposit of an amount not less than \$——. Interest thereon at the rate of —— per cent per annum, payable upon the return of the deposit or annually upon request of the customer, shall be paid by the company.

Sec. 5. Records.—(a) The company shall keep a record (1) of the names and addresses of all its customers and the company's serial number of the meter or meters used by each customer; (2) of all its meters, showing dates of installation and removal.

(b) The company shall keep a full and complete record of the results of all meter tests, showing the errors of meters as found and as left after test and adjustment, the reason for making the test, and the date when test was made. This record shall be kept for at least five years.

Sec. 6. Meter Installation and Testing.—(a) No watthour meter shall be placed in service or be allowed to remain in service which creeps or which has incorrect constants or is in any way mechanically defective. A meter creeps when with all load wires disconnected the moving element makes one complete rotation in five minutes or less.

(b) All watthour meters either before installation or within 60 days after being installed by the company on any customer's premises shall be tested for accuracy of adjustment and registration at approximately one-tenth and three-quarters of the rated capacity of the meter, commonly called light load and heavy load, respectively. All meters so tested and found in error in comparison with suitable standards shall be adjusted to register correctly to within plus 2 or minus 4 per cent at light load and to within plus or minus 2 per cent at heavy load.

(c) All watthour meters installed upon customers' premises shall be periodically tested by the company in accordance with the following schedule, and if found in error shall be adjusted to register correctly, as specified in (b) of this section:

1. Single-phase induction-type meters of rated capacity up to and including 25 amperes shall be tested at least once in every 36 months.

2. Single-phase induction-type meters of rated capacity exceeding 25 amperes, and all polyphase, commutator, and mercury type meters, shall be tested at least once in every 24 months.

Sec. 7. Voltage Variations and Voltage Records.—(a) The company shall adopt a standard voltage for its constant-voltage lighting system, and should make every reasonable effort to maintain

such voltage, as measured at the company's service terminals, so that variations of more than 5 per cent above or 5 per cent below such standard shall not occur between sunset and 11 o'clock p. m. (lighting hours), and the total variation of voltage from minimum to maximum shall not exceed 6 per cent of the average voltage. However, voltage variations caused by the operation of apparatus on the customer's premises necessarily requiring large starting currents, or in violation of the company's rules, or the action of the elements, shall not be considered a violation of this section.

(b) The company shall provide itself with one or more recording voltmeters of the type and capacity suited to its system. These recording instruments shall be kept continuously in use somewhere on the company's system.

Sec. 8. Meter Testing on Request of Customer.—(a) The company shall upon the written request of any customer make, without charge, a test of the accuracy of his watthour meter, provided the customer does not make request for tests more frequently than once in 12 months. Such tests shall be made in the presence of the customer, if he desires it, with suitable testing instruments, and a written report giving the result of such test shall be made to the customer. The record of all such tests shall be kept on file in the office of the company for at least one year and be open to inspection upon demand by the customers affected.

(b) Tests shall be made with the meter in place of operation on the customer's premises and under local conditions of operation.

(c) If any test made upon a customer's complaint shows his meter, in comparison with suitable testing standards, to be in error to the prejudice of the customer in excess of 4 per cent, as averaged on light and heavy load,⁶⁰ the company shall refund to the complaining customer an amount equal to the excess charged for the kilowatthours incorrectly metered over a period equal to one-half of the time elapsed since the last previous test, but not to exceed six months. After tests, meters shall be adjusted to register correctly to within the limits specified in section 6 (b) of this ordinance.

Sec. 9. Meter Readings and Bill Forms.—(a) Bills rendered to customers periodically for electric service shall show the readings of the meter at the beginning and end of the interval for which the bill is rendered, the dates upon which the readings were taken, and all other essential facts upon which the bill is based.

⁶⁰ See p. 200 for another method for finding the average error of a meter.

(b) The company shall adopt some method of informing its customers as to the reading of meters, either by printing on bills a description of the method of reading meters, by distributing booklets or folders, or by a notice that the method will be explained at the office of the company upon request.

Sec. 10. Interruption of Service.—The company shall keep a careful record of all interruptions of service upon its entire system or major portions thereof. Such record shall include the time, duration, and cause of each interruption, and shall be open to the inspection of customers affected.

Sec. 11. Complaints.—The company shall make an investigation of all reasonable complaints made to it by its customers, or by the city, and it shall keep a record of all such complaints, which record shall include the name and address of the complainant, the date, the character of the complaint, and the adjustment or disposition made thereof. This record shall be open to the inspection of customers affected.

Sec. 12. Penalties.—Upon violation of any section of this ordinance, or failure to comply with any provision hereof, the company shall upon conviction be subject to and shall pay to the city a penalty of not less than ——— nor more than ——— for such offense; and each day's continuance of such violation or failure to comply shall be deemed a separate offense.

Sec. 13. Repeal.—All ordinances or parts thereof inconsistent with the terms of this ordinance are hereby repealed.

Sec. 14. Application of Ordinance—Time of becoming effective.—(a) This ordinance shall apply to any person, firm, or corporation now or hereafter engaged in the business of furnishing electrical energy in the city of ———. The word "company" shall be construed to refer to any such person, firm, or corporation.

(b) This ordinance shall take effect and be in force from and after ———.

NOTE.—The inclusion of the following sections may be desirable in many cities. Provision is made in these sections for a municipal officer to handle questions as between the city or individuals and the company.

Sec. 15. Inspector.—The city engineer, ⁶¹ ex officio, shall, under the control and direction of the city council, act as inspector of electric service and meters.

⁶¹ City electrician or city sealer of weights and measures may be designated city inspector of meters and service.

(a) He shall receive and make investigations of complaints regarding electric service, and the accuracy of electric meters.

(b) He shall receive and file the reports made by the company.

(c) He shall perform any and all other duties naturally connected with his office as required or implied by any part of this ordinance, or as may be especially assigned to him at any time by the mayor and city council.

Sec. 16. Reports from the company.—The company shall make quarterly reports to the city inspector of meters of the results of all tests which it has made in accordance with the requirements of this ordinance. These reports shall be kept on file in the office of the inspector and shall be open to public inspection.

3. FOR LARGER CITIES

AN ORDINANCE Providing for the appointment of an inspector of electric meters and service and defining the duties of such office; prescribing rules and regulations for standards of electric service; and otherwise regulating the service of electric companies supplying light, heat, and power.

Sec. 1. Definitions.—In this ordinance and the various sections and parts thereof the word “city” shall be construed to refer to the city of ———; the words “company” and “companies” to the company or companies authorized by law to generate, transmit, distribute, and sell electrical energy for light, heat, or power in said city of ———; the word “customer” shall include any person, company, corporation, or other party to whom said company or companies shall furnish electrical energy for use within said city; and the words “mayor,” “city clerk,” “city treasurer,” “inspector,” and “city council” shall be understood to refer to the mayor, the city clerk, the city treasurer, the inspector of electric meters and service, and the city council of said city of ———, respectively.

Sec. 2. Appointment of Inspector.—(a) The mayor, subject to the approval of the city council, shall appoint as inspector of electric meters and service a suitable person who is qualified and recommended to the mayor and the city council, as follows: ——— and ——— and ——— shall constitute a board⁶² for the examination of all persons who shall apply for the position of inspector or deputy inspector. Said board shall give the public notice of the time and place of such examination at least one month before the same is to be held, and the notice shall be

⁶² In many cities the existing civil-service commission would, of course, be the examining board. In case there is no civil-service commission, the city engineer, board of public works, superintendent of public schools, city electrician, or principal of high school may be designated as the examining board.

published in the official papers of the city at least twice each week during said month. At the time and place so fixed the board shall examine all applicants, in such a manner as it shall deem necessary to determine their technical knowledge and competency to perform all the duties of inspector or deputy inspector, as called for in this ordinance. Within one month after such examination said board shall certify to the mayor and the city council the names of such persons as said board shall deem fully competent to perform such duties. Only persons whose names are so certified shall be eligible to be appointed inspector or deputy inspector: *Provided, however,* That any person who shall previously have held the office of inspector under the provisions of this ordinance may be reappointed to said office without such certificate from the board: *Provided, also,* That a person who has once been certified as competent by said board shall be subsequently eligible for appointment without again being examined during a period of five years from such first examination.

(b) The inspector, his deputies, or his assistants, shall not be pecuniarily interested, either directly or indirectly, in the manufacture or sale of electrical energy, electric meters, or any article or commodity used by electric companies, or used for any purpose connected with the use of electrical energy. The inspector, his deputies, or his assistants, shall not give certificates or written opinions to a maker or vender of such articles or commodity.

(c) The inspector, appointed as hereinabove provided, shall take an oath of office such as is required of other city officials and he shall serve for a term of four years, or until his successor shall be properly appointed. He shall be eligible for reappointment without reexamination.

(d) The mayor may remove the inspector at any time for sufficient cause, but notice shall first be given to the incumbent of the charges against him, and he shall be given a period of 10 days in which to answer such charges. All such charges and the incumbent's defense against them shall be made a matter of public record: *Provided, however,* That at the time when first appointed, the appointee shall serve for a probationary period of six months; and he may be removed by the mayor during said six months without the notice of charges against him, as is required above.

(e) The salary of said inspector shall be ——— per annum, payable monthly.

Sec. 3. Deputies and Assistants.—(a) The inspector, with the consent and approval of the mayor, may appoint one or more deputy inspectors. Only those persons who shall have been examined by the board of examiners provided for in section 2, and who shall have been certified by said board as competent to become deputy inspectors, shall be eligible to be appointed as deputy inspectors. Said deputies so appointed shall have the power, under the direction of the inspector, to perform any duty which may be required of the inspector under the provision of this ordinance.

(b) The inspector, with the consent and approval of the mayor, may appoint one or more assistants or clerks (who need not necessarily be competent to make the tests herein provided for) who shall, under his direction, aid in the performance of the duties of this office.

(c) Each of said deputies and assistants shall take an oath of office such as is regularly required of other city officers.

(d) The salary of a deputy inspector shall be ——— per annum payable monthly.

Sec. 4. Duties of the Inspector.—The inspector, in person or by deputy or properly qualified assistant, shall perform the following duties:

(a) He shall have full charge of all apparatus, laboratories, and offices provided for his work.

(b) He shall test and determine the adequacy and quality of the electric service furnished.

(c) He shall examine all rates and rate schedules for electric service and advise the mayor and council with reference to all such rates and rate schedules filed by the company in his office.

(d) He shall receive and investigate complaints from customers of the company regarding the voltage of the service furnished, the accuracy of meters, the efficiency of incandescent lamps furnished, and any other reasonable complaints made by customers.

(e) He shall test service meters upon the written application of any customers desiring such test.

(f) He shall test and certify all reference standards used by the company at least once a year.

(g) He shall keep a careful record of all complaints received and investigated, tests made, and instruments certified.

(h) He shall make regular monthly reports to the mayor or council and special reports when the adequacy and quality of service do not conform to the requirements of this ordinance.

(i) He shall perform any and all other duties naturally connected with his office as required or implied in this ordinance.

Sec. 5. Testing Laboratory.—The city shall provide and maintain a testing laboratory, and shall equip it with such apparatus and facilities as may, in the judgment of the inspector, be necessary to carry out the provisions of this ordinance.^{62a}

The inspector shall have custody and control of said laboratory and its equipment and maintenance. He shall have available at all times properly certified instruments for the measurement of electromotive force and current, and it shall be the duty of the inspector to have such instruments tested and certified periodically by the Bureau of Standards at Washington, or by some other standardizing laboratory of recognized standing.

Sec. 6. Maintenance of Plant.—Each company shall maintain its entire plant and system in such condition as will enable it to furnish safe, adequate, and continuous service within its hours of operation.

Sec. 7. Accepted Practice.—The company's generating and distributing system, including (a) generating equipment; (b) transmission lines; (c) substations; (d) overhead system, poles, lines, transformers, etc.; (e) underground systems, manholes, conduits, etc.; (f) street-lighting system; (g) service wires and attachments; and (h) meters, etc., must be constructed, installed, and maintained in accordance with accepted good practice. It is expected that all possible care will be exercised by each company to reduce the life hazard (1) to which employees are subjected in working in generating stations and substations and on overhead and underground lines; (2) to which the company's customers may be subjected by the introduction of its wires into the residences of the customers; (3) and to which the general public may be subjected by the presence of overhead wires in the public streets and ways.

Sec. 8. Grounding of Low-Potential Circuits.—The rules concurrently in force contained in the National Electrical Safety Code regarding grounding of low-potential circuits are hereby adopted for all new construction. Each company shall adopt a plan whereby existing ungrounded circuits shall be grounded in conformity with this section and submit the same to the inspector for approval by ——— 191—.

Sec. 9. Location of Meters.—It is recommended that all meters hereafter installed on customers' premises should be located in the

^{62a} In case an adequate laboratory already exists in the city, this section should be so drawn as to take advantage of it if proper arrangements can be made for such laboratory's cooperation with the city.

cellar or first floor, or as near as possible to the service, in a clean, dry, safe place, not subject to great variation in temperature, on a support free from vibration, and easily accessible for reading and testing. Unless unavoidable, meters should not be installed in attics, sitting rooms, bathrooms, restaurant kitchens, over doors, over windows, or any location where the visits of the meter reader or tester will cause annoyance to the customer.

Sec. 10. Meter-Testing Equipment.—(a) *Working Standards.*—The company shall provide for and have available portable “working” standards, such as indicating electrical testing instruments, portable watthour meters, and other apparatus and equipment necessary for testing customer’s service meters in compliance with the requirements of this ordinance.

(b) *Check of Working Standards.*—The company shall provide for and have available as check or reference standards electrical indicating instruments and watthour meters, the accuracy of which shall be satisfactory to and certified by the inspector. All meters and instruments used for testing customer’s service meters shall be checked against such reference standards at least weekly when regularly in use, and records kept of all checks made. Whenever any such check shows a meter or instrument not accompanied by a calibration card to be incorrect more than 1 per cent of full-scale value at any ordinarily used load, the meter or instrument shall be recalibrated.

Sec. 11. Place and Method for Meter Testing.—(a) All tests on service meters provided for in this ordinance shall be made in the place of permanent location on the customer’s premises with approved testing apparatus, and under local conditions, unless otherwise stated in any section of this ordinance.

(b) Meters installed with instrument transformers or shunts shall be tested jointly with such transformers or shunts, otherwise the ratio of transformation of the transformers and the resistance of the shunts must have been previously determined within five years and be on file at the office of the utility for use in calculating results of tests. Such tests must have been made by a laboratory of recognized standing or by the utility, using apparatus and methods satisfactory to the inspector.

(c) Meters that operate on loads of low power factor (lagging current) shall be tested and adjusted before installation to register correctly to within 2 per cent at a power factor of approximately 50 per cent and at approximately 100 per cent of rated current.

Sec. 12. Accuracy Requirements for Watthour Meters.—(a) No watthour meter that has an incorrect register constant, test constant, gear ratio, or dial train, or which registers upon no load ("creeps"), shall be placed in service or be allowed to remain in service without adjustment and correction.

(b) No watthour meter that has an error in registration of more than plus 2 or minus 4 per cent at light load or plus or minus 2 per cent at heavy load shall be placed in service. Wherever on installation, periodic, or any other test a meter exceeds these limits it must be adjusted. A meter creeps when, with all load wires disconnected, the moving element makes one complete rotation in five minutes or less.

(c) Light load shall be approximately 5 to 10 per cent of the rated capacity of the meter. Heavy load shall be not less than 60 nor more than 100 per cent of the rated capacity of the meter.

Sec. 13. Installation Tests.—All watthour meters shall be tested and adjusted by the company to register accurately to within the limits specified in section 12(b), before installation or within 60 days after installation. All direct-current meters shall be tested for accuracy within 60 days after installation.

Sec. 14. Periodic Tests of Watthour Meters.—All watthour meters installed upon customer's premises shall be periodically tested by the company according to the following schedule:

Schedule for Periodic Testing of Watthour Meters

	Rated capacity of meter in amperes or kilovolt-amperes	To be tested at least once in every—
Direct-current meters.....	Exceeding 500 amperes.....	6 months.
	500 amperes to 15 amperes.....	18 months.
	15 amperes and less.....	24 months.
Alternating-current meters:		
1. Single-phase.....	Exceeding 25 amperes.....	24 months.
	25 amperes and less.....	36 months.
2. Polyphase.....	Exceeding 50 kilovolt amperes.....	12 months.
	50 kilovolt amperes and less.....	24 months.

(b) Each company shall, as soon as possible after the adoption of this ordinance and with the approval and consent of the inspector, arrange to begin a schedule of meter testing as herein provided, testing meters installed longest first, and arrange such schedule so as to test all meters at least once in the periods above specified.

Sec. 15. Records and Reports.—(a) Each company shall keep a complete record of all watthour meters installed on customer's

premises. Such record shall include: Company's number of meter; manufacturer's name and number of meter; type and capacity of meter; constants of the meter; date of each installation, removal, and test; the error at heavy load and at light load as found at each test; and the accuracy of adjustment as left after test.

The record of tests of each meter shall be continuous for at least two test periods and in no case for less than five years.

(b) The test records of each company shall be available for examination at any time by the inspector.

(c) A report shall be made by each company to the inspector at stated intervals, giving a summary of the tests. Blank forms will be furnished by the inspector on which reports are to be made.

(d) Each company shall report to the inspector before ——— the types and numbers of meters in its service, and yearly thereafter.

Sec. 16. Tests upon Request of Customer.—Each company shall, without charge, make a test of the accuracy of a meter upon request of a customer, provided such customer does not make a request for test more frequently than once in 12 months. A report giving results of such tests shall be made to the customer, and a complete record of such tests shall be kept on file at the office of the company.

Sec. 17. Tests by Inspector.—Upon written application by any customer to the inspector a test shall be made of the customer's meter by the inspector, such test to be made as soon as practicable after receipt of the application. For such a test a fee of ——— shall be paid by the customer at the time application is made for the test, this fee to be retained if the meter is found to be slow or correct. If the meter is found to be more than 4 per cent fast the amount of the fee will be refunded to the customer and collected from the company owning the meter. The company owning the meter will be notified that such test is to be made and should have a representative present to open the meter, assist in the test and adjust and seal the meter after the test.

Sec. 18. Record of Complaints.—Each company shall keep a record of written "complaints" received at its office in regard to service, which shall include the name and address of the customer, the date, nature of complaint, and the remedy. The record shall be available for inspection at any time within six months by the inspector.

Sec. 19. Information on Bills.—Bills rendered periodically by the company shall show the readings of the meter at the beginning and

end of the time for which bill is rendered, the dates on which the readings were taken, and all the other essential facts upon which the bill is based.

Sec. 20. Information as to Meter Reading.—Each company shall adopt some method of informing its customers how meters are read, either by printing on bills a description of the method of reading meters or by a notice to the effect that the method will be explained on application.

Sec. 21. Incandescent Lighting.—Each company shall render its customers reasonable assistance in securing incandescent lamps best adapted to the service furnished. Lamps furnished by the company without charge (free renewals) or at prices less than open-market prices, should be of such efficiency in watts per candle, when used on the company's circuits of standard voltage as specified in section 23, that customers may obtain their lighting service under the most favorable conditions practicable under the rate schedule.

Sec. 22. Information as to Kinds of Service.—Each company shall furnish to any prospective customer, on request, a statement of the kind or kinds of service available, giving the standard voltage, nature of current, and if alternating current, the frequency and number of phases, and full schedule of rates. Where one class of service is available through only a part of the district served, this shall be stated in connection with any such request.

Sec. 23. Standard Voltage and Permissible Voltage Variations.—Each company shall adopt a standard voltage or standard voltages for its constant-voltage lighting system (or for each of the several districts into which the system may be divided) and shall maintain such voltage as measured at the company's service terminals, so that variations of more than 5 per cent above or 5 per cent below such standard voltage shall not occur between sunset and 11 p. m., and the total variation of voltage from minimum to maximum shall not exceed 6 per cent of the average voltage: *Provided, however,* That variations in voltage caused by the operation of apparatus on the customer's premises necessarily requiring large starting currents or in violation of the company's rules, or the action of the elements, shall not be considered a violation of this section.

Sec. 24. Voltage Surveys.—Each company shall provide itself with one or more portable indicating voltmeters, and one or more recording voltmeters, these instruments to be of a type and

capacity suited to the voltage supplied. Each company shall make a sufficient number of voltage surveys to indicate the service furnished from each center of distribution to satisfy the inspector of its compliance with the voltage requirements, and shall keep at least one recording voltmeter in continuous service at the plant, office, or some customer's premises. Voltmeter records must be available to the inspector on demand.

Sec. 25. Station Records and Interruptions of Service.—Each company shall keep a record of the time of starting and shutting down station apparatus, together with the indications of the principal switchboard instruments at frequent intervals, and shall maintain a record of all interruptions of service upon the entire system or major divisions of its system, and include in such record time, duration, and cause of each interruption.

Sec. 26. File of Rate Schedules and Rules.—Each company shall file copies of all schedules of rates and of all rules and regulations in the office of the inspector. A copy of all rate schedules, of all company rules and regulations, and of this ordinance furnished by the inspector, shall be on file in the office of the company and shall be open to public inspection.

Sec. 27. Refunds and Prorated Bills.—(a) Whenever a meter is found upon test, made by the company or the inspector, at the request of the customer, to be more than 4 per cent in error at any load, additional tests shall be made to determine the average error of the meter.

(b) *Average error.*—The average error of a meter in tests made by the inspector or company, at the request of the customer, shall be determined by one or the other of the following methods:

Method A: Take one-fifth of the algebraic sum of (1) the error at light load; (2) three times the error at normal ^{62b} load; (3) the error at full rated capacity.

Method B: Take one-half the algebraic sum of (1) the error at light load; (2) the error at heavy load.

(c) When a meter is found to have a positive average error—i. e., is fast—in excess of 4 per cent, in tests made at the request

^{62b} In determining normal load the following percentages of the several classes of full connected installations may be used:

	Per cent
(a) Residence and apartment lighting.....	25
(b) Elevator service.....	40
(c) Factory lighting, individual drives, churches, offices, stables, and hotels.....	45
(d) Factory shaft drive, theaters, clubs, hallways, entrances, and general store lighting.....	60
(e) Saloons, restaurants, pumps, air compressors, and ice machines.....	70
(f) Sign and window lighting, blowers, moving-picture machines.....	100

of the customer, the company shall refund to the customer an amount equal to the excess charged for the kilowatt hours incorrectly metered, for a period equal to one-half of the time elapsed since the last previous test, but not to exceed six months.

(d) When a meter is found to have a negative average error—i. e., is slow—in excess of 4 per cent, in tests made at the request of the customer, the company may make a charge to the customer for the kilowatt hours incorrectly metered for a period equal to one-half of the time elapsed since the last previous test, but not to exceed six months. If a meter is found not to register for any period, the company shall estimate and charge for the kilowatt hours used by averaging the amounts registered over similar periods, preceding or subsequent thereto, or over corresponding periods in previous years.

Sec. 28. Deposits.—Each company may require from any customer or prospective customer a deposit^{62c} of an amount not less than ———. Interest thereon at the rate of — per cent per annum, payable upon the return of the deposit, or annually upon request of the customer, shall be paid by the utility to each customer making such deposit, for the time such deposit was held by the company and the customer was served.

Each company shall issue to every customer from whom a deposit is received a certificate of deposit, and shall provide reasonable ways and means whereby a depositor who makes application for the return of his deposit, or any balance to which he is entitled, but is unable to produce the original certificate of deposit, may not be deprived of his deposit or balance.

Sec. 29. Repeal.—All ordinances and parts thereof contravening or inconsistent with the terms of this ordinance are hereby repealed.

Sec. 30. Time of Becoming Effective.—This ordinance shall take effect and be in force from and after ———.

^{62c} See footnote, p. 161.

APPENDIXES

APPENDIX 1

1. SUMMARY OF STATE LAWS NOW ENACTED PROVIDING FOR THE REGULATION OF ELECTRIC SERVICE

The laws of the various States on the general subjects discussed in this circular are here collected for ready reference. As far as possible all legislation to date (1915) has been included in this summary.

It is believed that all the most important provisions of State laws are included, though there are no doubt certain sections omitted from the laws given that may have a general bearing on the question of electric service.

In most States the regulation of gas and electric service is provided for in the same section of the law, though this is not true in all cases. This difference explains the mention of gas service in some laws and not in others, as here quoted. Sections dealing exclusively with gas service are omitted.

To facilitate further reference a list of statutes is given below, alphabetically, by States.⁶³

The following States at this time (1915) have no laws on electric service, as discussed in this circular: Alabama, Arkansas, Florida, Iowa, Kentucky, Louisiana, Michigan,⁶⁴ Minnesota; Mississippi, Nebraska, New Mexico, North Dakota, South Carolina,⁶⁵ South Dakota, Tennessee, Texas, Utah.

List of Statutes Covering Subject of Electric Service

ARIZONA

Session Laws, 1912, chapter 90. An act relating to public-service corporations, providing for the regulation of the same, fixing penalties for the violation thereof, and repealing certain acts, with an emergency clause. Approved May 28, 1912.

Session Laws, 1912, special session, chapter 52. An act providing for the sale of water, gas, and electricity by meter measurement; for inspection of water, gas and electric meters. * * * Approved June 19, 1912.

⁶³ For complete compilations of the public-utility laws of the States, reference should be made to the following: (1) Proceedings of the Twenty-third Annual Convention of the National Association of Railway Commissioners; Compilation of the Laws of the States Pertaining to Railways and other Public-Service Corporations; Traffic Service Bureau, Chicago, 1912. (2) Commission Regulation of Public Utilities; A Compilation and Analysis of Laws of Forty-three States and of the Federal Government for the Regulation by Central Commissions of Railroads and other Public Utilities; The National Civic Federation, New York, 1913.

⁶⁴ In Michigan the railroad commission has jurisdiction over transmission of electricity "in or on the public highways, streets, and places, and the rate of charge to be made to the consumer. * * *"

⁶⁵ South Carolina Public Service Commission has authority only "to fix and establish (certain cities of the State excepted) maximum rates and charges for the supply of water, gas, and electricity."

CALIFORNIA

Statutes of 1911, extra session, chapter 14, public utilities act. An act to provide for the organization of the railroad commission. * * * In effect March 23, 1911. Chapter 9, as amended, 1915. In effect August 8, 1915.

COLORADO

Session Laws, 1913, chapter 127. An act concerning public utilities, creating a public-utilities commission, prescribing its powers and duties. * * * Approved April 12, 1913. Effective August 15, 1914.

CONNECTICUT

Public Acts, 1911, chapter 128. An act concerning the regulation and supervision of public-service corporations. Approved July 11, 1911.

DELAWARE

Laws of Delaware, 1911, volume 26, chapter 206, public-utility commission. An act to create a board of public-utility commissioners for the city of Wilmington and prescribe its duties. Approved March 29, 1911.

DISTRICT OF COLUMBIA

Public—No. 435, H. R. 28499. An act making appropriations for the expense of the government of the District of Columbia for the fiscal year ending June 30, 1914, and for other purposes. Approved March 4, 1913.

GEORGIA

Code, 1911. An act to increase the membership of the Railroad Commission of Georgia. Approved August 22, 1907.

IDAHO

House Bill No. 21, session laws, 1913. An act to provide for the organization of the public utilities commission. * * * Approved March 13, 1913.

ILLINOIS

House Bill No. 907, public utilities commission law. An act to provide for the regulation of public utilities. Approved June 30, 1913. In effect January 1, 1914.

INDIANA

Acts of 1913, sixty-eighth session, chapter 76. An act concerning public utilities, creating a public service commission. Approved March 4, 1913. In effect May 1, 1913.

KANSAS

Laws, 1911, chapter 238. An act relating to public utilities and common carriers, being an act creating the public utilities commission. * * *

MAINE

Seventy-sixth legislature, Senate No. 453, chapter 129. An act to create a public utilities commission, prescribe its powers and duties, and provide for the regulation and control of public utilities. Effective September, 1914.

MARYLAND

Laws, 1910, chapter 180, public-service commission law. An act to create and establish a public-service commission and prescribing its powers and duties. * * * Amendments, 1912 and 1914. Approved April 5, 1910.

MASSACHUSETTS

Acts of 1914, chapter 742. An act to consolidate the laws relating to the manufacture, distribution, and sale of gas and electricity. Approved July 3, 1914.

MICHIGAN

Public Acts, 1909, No. 106. An act to regulate the transmission of electricity.
* * * Approved May 19, 1909.

MISSOURI

Laws, 1913. Public-service commission law. Approved March 17, 1913. In effect April 15, 1913.

MONTANA

Session Laws, 1913, chapter 52, public-service commission law. An act making the board of railroad commissioners of the State of Montana *ex officio* a public-service commission. * * * Approved March 4, 1913.

NEVADA

Laws, 1911, public-service commission law. An act making the Railroad Commission of Nevada *ex officio* a public-service commission. * * * Approved March 23, 1911.

NEW HAMPSHIRE

Public Acts, 1911, chapter 164. An act to establish a public-service commission. Approved April 15, 1911. In effect May 15, 1911.

Public Acts, 1913, chapter 124. An act providing for the inspection of the service equipment of public utilities by the Public Service Commission. Approved May 7, 1913.

NEW JERSEY

Laws, 1911, chapter 195. An act concerning public utilities, to create a board of public-utility commissioners and to prescribe its duties and powers. Approved April 21, 1911. In effect May 1, 1911.

NEW YORK

Acts of 1910, chapter 480. An act in relation to public-service commissions. Became a law June 14, 1910. Chapter 429, laws of 1907 * * * is amended by the above, and as amended is the public-service commissions law.

NORTH CAROLINA

Public Laws, session 1913, chapter 127. An act to regulate electric light, power, water, and gas companies. Ratified March 11, 1913.

OHIO

Laws of Ohio relating to the Public Utilities Commission, 1913. In effect August 9, 1913.

OKLAHOMA

House Bill No. 156. An act to extend the jurisdiction of the corporation commission over the rates, charges, services, and practices of water, heat, light, and power companies, and to give said commission general supervision over such utilities, and declaring an emergency. Approved March 25, 1913.

OREGON

Laws of 1911, chapter 279. Public-utility act of the State of Oregon. Compiled and annotated for the Railroad Commission of Oregon. Act effective by vote of people November 5, 1912.

PENNSYLVANIA

Act of July 26, 1913, No. 854. An act defining public-service companies, and providing for their regulation, etc. * * * Approved July 26, 1913. In effect January 1, 1914.

RHODE ISLAND

Public Laws, 1912, chapter 795. An act to create and establish a public-utilities commission and prescribe its powers and duties, and to provide for the regulation and control of public utilities. Approved April 17, 1912.

SOUTH CAROLINA

Acts of 1910, No. 286. An act to establish a public-service commission, to fix and establish in all cities of this State charges for the supply of water, gas, or electricity furnished by any person, firm, or corporation, to such city and the inhabitants thereof and to prescribe penalties. Approved February 23, 1910.

VERMONT

Acts of 1908, No. 116. An act changing the name of the Board of Railroad Commissioners to Public Service Commission and providing for the supervision of gas plants, electric-light plants, telegraph and telephone lines, and express companies. Approved January 20, 1909. In effect April 1, 1909.

VIRGINIA

Chapter 340. An act imposing public duties on heat, light, power, water, and telephone companies, and providing for the control and regulation of such companies by the State Corporation Commission. Approved March 27, 1914.

WASHINGTON

Laws of 1911, chapter 117. An act relating to public-service properties and utilities, providing for the regulation of the same, fixing penalties for the violation thereof, making an appropriation, and repealing certain acts. Approved March 18, 1911. In force June 8, 1911.

WEST VIRGINIA

Laws of 1913. An act to create a public-service commission and to prescribe its powers and duties, and to prescribe penalties for the violation of the provisions of this act. Passed February 20, 1913.

Laws of 1915. An act to amend and reenact sections * * * of chapter 9 of acts of 1913 creating a public-service commission, etc. In effect May 17, 1915.

WISCONSIN

Laws of 1907, chapter 499. Public-utilities law of Wisconsin, section 1797m-1 to 1797m-109. (Amendments in 1911.)

WYOMING

Chapter 146, Senate file No. 5, the public-utilities act. An act regulating public utilities, creating and establishing a public-service commission. * * * Approved March 4, 1915.

Sections of Laws Relating to Electric Service

ARIZONA

SEC. 13. (b) Every public service corporation shall furnish, provide, and maintain such service, instrumentalities, equipment, and facilities as shall promote the safety, health, comfort, and convenience of its patrons, employees, and the public, and as shall be in all respects adequate, efficient, just, and reasonable.

(c) All rules and regulations made by a public-service corporation affecting or pertaining to its charges or service to the public shall be just and reasonable.

SEC. 35. Whenever the commission, after a hearing had upon its own motion or upon complaint, shall find that the rules, regulations, practices, equipment, appliances, facilities, or service of any public-service corporation, or the methods of manufacture, distribution, transmission, storage, or supply employed by it, are unjust, unreasonable, unsafe, improper, inadequate, or insufficient, the commission shall determine the just, reasonable, safe, proper, adequate, or sufficient rules, regulations, practices, equipment, appliances, facilities, service, or methods to be observed, furnished, constructed, enforced, or employed, and shall fix the same by its order, rule, or regulation. The commission shall prescribe rules and regulations for the performance of any service or the furnishing of any commodity of the character furnished or supplied by any public-service corporation, and upon proper demand and tender of rates such public-service corporation shall furnish such commodity or render such service within the time and upon the conditions provided in such rules.

SEC. 46. (a) The commission shall have power, after hearing had upon its own motion or upon complaint, to ascertain and fix just and reasonable standards, classifications, regulations, practices, measurements, or service to be furnished, imposed, observed, and followed by all electrical, gas, and water corporations; to ascertain and fix adequate and serviceable standards for the measurement of quantity, quality, pressure, initial voltage, or other conditions pertaining to the supply of the product, commodity, or service furnished or rendered by any such public-service corporation, to prescribe reasonable regulations for the examination and testing of such produce, commodity, or service and for the measurement thereof; to establish reasonable rules, regulations, specifications, and standards to secure the accuracy of all meters and appliances for measurements; and to provide for the examination and testing of any and all appliances used for the measurement of any product, commodity, or service of any such public-service corporation.

(b) The commissions and their officers and employees shall have power to enter upon any premises occupied by any public-service corporation for the purpose of making the examinations and tests and exercising any of the other powers provided for in this act, and to set up and use on such premises any apparatus and appliances necessary therefor. The agents and employees of such public-service corporation shall have the right to be present at making of such examinations and tests.

(c) Any consumer or user of any product, commodity, or service of a public-service corporation may have any appliance used in the measurement thereof tested upon paying the fees fixed by the commission. The commission shall establish and fix reasonable fees to be paid for testing such appliances on the request of the consumer or user, the fee to be paid by the consumer or user at the time of his request, but to be paid by the public-service corporation and repaid to the consumer or user if the appliance is found defective or incorrect to the disadvantage of the consumer or user under such rules and regulations as may be prescribed by the commission. (Session Laws, 1912, chap. 90, regular session.)

SEC. 2. It shall be the duty of the State inspector of weights and measures in unincorporated or incorporated cities or towns with a population of not more than 5000 nor less than 1000 inhabitants, according to the latest official State or United States census, at least once in every two years, and as much oftener as he may deem necessary, to test the accuracy of every meter used or to be used in the measuring of any water, electricity, or gas furnished or to be furnished to the customer through such meter. If the meter tested shall upon test thereof by the inspector be found to measure too fast or too slow by as much as 3 per cent, such meter shall be condemned by him and shall not be again used, or used at all until corrected and made to measure accurately. Unless any water, gas, or electric meter is made to conform with the standard of such State inspector within 30 days after the date of the condemnation by such inspector, the said State inspector is not required to retest such condemned water, gas, or electric meter for a period of one year thereafter.

The State inspector shall keep in a book, together with a card-index system to be furnished him by the State, a complete list of meters inspected and tested by him, the name of the person, firm, or corporation owning the same, the name of the furnisher of the water, gas, or electricity, the name of the consumer thereof, and the date and result of all inspections, and shall at all times keep the same open to the inspection of the public.

SEC. 3. He shall, upon the written request of any citizen, firm, or corporation, or educational institution in the State, test any water, gas, or electric meters used as standards in the State. He shall at least once every year test all water, gas, and electric meters used in any institution for the maintenance of which moneys are appropriated by the legislature, and he shall report in writing his findings to the supervisory board and to the executive officers of the institution concerned.

SEC. 4. It shall be the duty of the city sealer ^{65a} in unincorporated or incorporated cities of not less than 5000 population, according to the latest official State or United States census, at least once every two years, and as much oftener as may in his judgment be necessary, or whenever requested in writing by either the furnisher of water, electricity, or gas, or by the consumer of the same, to test the accuracy of any meter used or to be used in the measuring of any water, electricity, or gas furnished or to be furnished to the consumer through such meter. If the meter tested shall upon test thereof by the sealer be found to measure too fast or too slow by as much as 3 per cent, such meter shall be condemned by him, and the owner or owners of the same shall be notified of the condemnation at the time when such condemnation is made by the city sealer, and such meter shall not be again used or used at all until corrected and made to measure accurately.

The city sealer shall keep in a book, together with a card-index system to be furnished him by the city, a complete list of all meters inspected and tested by him, the name of the person, firm, or corporation owning the same, the name of the furnisher of the water, gas, or electricity, the name of the consumer thereof, and the date and result of all inspections, and shall at all times keep the same open to the inspection of the public.

SEC. 5. Where water, electrical energy, or illuminating gas is or shall hereafter be sold for the purpose of lighting, heating, or other domestic uses in the State of Arizona, the same shall be furnished, sold, delivered, charged, and paid for by meter measurement, if the consumer shall so request of the furnisher; and the meter to be used in measuring the same shall be of standard make, and may be furnished and installed in position for use by either the furnisher of the water, electricity, or gas, or by the consumer of the same.

SEC. 6. It shall be unlawful for any person, firm, or corporation in any city having a city sealer of weights and measures to install any water, electric, or gas meter for measuring water, electricity, or gas for purposes of lighting, heating, or other commercial or domestic uses without first having had such meter tested by the city sealer of weights and measures.

SEC. 7. It shall be unlawful for any person, firm, or corporation to sell and deliver, charge and collect for, or pay for water, electrical energy, or illuminating gas used or to be used for lighting, heating, or other commercial or domestic purposes, except by meter measurement, if the consumer shall request that the same be sold by meter measurement, or to charge and collect for or pay for a greater amount of such water, electrical energy, or illuminating gas than actually furnished during the period for which the charge was made: *Provided, however*, that an allowance of not exceeding 3 per cent may be made for inaccuracy in meter measurement.

^{65a} "All such weights and measures and other testing apparatus having been tried and accurately proved by him shall be sealed and certified to by the State inspector, as hereinbefore provided, and shall then be deposited with and preserved by the city sealer as the public standards for such city." (Sec. 4, chap. 91, Session Laws, 1912, regular session.)

SEC. 8. It shall be unlawful for any person, firm, or corporation to use any water, electric, or gas meter which shall have been tested and condemned by the State inspector or city sealer of weights and measures for the purpose of measuring water, electricity, or gas without first having had the same corrected and made to record the measurement of the same accurately.

SEC. 9. In cities having a sealer of weights and measures where water, illuminating gas, or electrical energy is or shall hereafter be sold, every person, firm, or corporation furnishing such water, gas, or electricity shall file at the office of the city sealer a complete written list of the readings of all water, gas, or electric meters, together with the individual meter numbers and the address of the premises upon which such meter is located upon the day such readings are made.

SEC. 10. The fee for making the test of any water, gas, or electric meter shall be the sum of \$1, and shall in all cases be advanced and paid by the party demanding the test, but in case the meter be one already in use and be found to be measuring too fast by as much as 3 per cent the inspector or sealer shall return the fee to the consumer if same was advanced by him, and the same shall be and become a lawful charge against the furnisher, and the inspector or sealer shall collect the fee from the said furnisher of water, gas, or electricity.

SEC. 11. Any person, firm, or corporation, or any agent or employee thereof, violating any of the provisions of this act shall, upon conviction thereof, be punished by a fine of not less than \$10 nor more than \$250, or by imprisonment in the county jail for not less than one day nor more than 90 days, or by both such fine and imprisonment.

SEC. 12. The continuance of such violation from day to day shall be deemed a separate offense as to each day on which such violation is continued.

SEC. 13. Such State inspector and city sealer of weights and measures shall be under the direction and control of the corporation commission in all functions connected with the inspection of water, gas, and electric meters, as herein provided.

SEC. 14. All acts and parts of acts in conflict with this act are hereby repealed. (Session Laws, 1912, chap. 52, special session.)

CALIFORNIA

The Arizona public service corporation act, approved May 28, 1912, is verbatim like the public utilities act of California, approved December 23, 1911, with the exception that the Arizona act reads "public service corporation" for "public utility" in the California act, and that the number and method of appointing the commissioners differ.

Reference is therefore here made to sections 13b, 13c, 35, 46a, 46b, and 46c of the law of Arizona above for provisions of California law. (Statutes, 1911, extra session, chap. 14.)

COLORADO

SEC. 13. (b) Every public utility shall furnish, provide and maintain such service, instrumentalities, equipment and facilities as shall promote the safety, health, comfort and convenience of its patrons, employees and the public, and as shall in all respects be adequate, efficient, just and reasonable.

SEC. 31. (a) The commission shall have power, after hearing had upon its own motion or upon complaint to ascertain and fix just and reasonable standards, classifications, regulations, practices, measurements or service to be furnished, imposed, observed and followed by all electrical, gas and water public utilities; to ascertain and fix adequate and serviceable standards for the measurement of quantity, quality, pressure, initial voltage or other conditions pertaining to the supply of the product, commodity or service furnished or rendered by any such public utility; to prescribe reasonable regulations for the examination and testing of such product, commodity or service and for the measurement thereof; to establish reasonable rules, regulations, specifications and standards to secure the accuracy of all meters and appliances for

measurement and weighing; and to provide for the examination and testing of any and all appliances used for the measurement or weighing of any product, commodity, or service of any such public utility.

(c) Any consumer or user of any product, commodity or service of a public utility may have any appliances used in its measurement thereof tested upon paying the fees fixed by the commission. The commission shall establish and fix reasonable fees to be paid for testing such appliances on the request of the consumer, the fee to be paid by the consumer or user at the time of his request, but to be paid by the public utility and repaid to the consumer or user if the appliance is found defective or incorrect to the disadvantage of the consumer or user, under such rules and regulations as may be prescribed by the commission.

SEC. 24. Same as Arizona, section 35, but for "public service corporation" read "public utility." (Session Laws, 1913, chap. 127.)

CONNECTICUT

SEC. 19. *Powers of commission concerning electricity and gas.*—The office of inspector general of gas meters and illuminating gas is hereby abolished, and the duties heretofore invested in said offices shall hereafter be performed by the commission. The commission shall also have power to fix the standard of illuminating and heating power, purity and quality of gas, to fix the initial efficiency of electric lamps furnished by electric companies, and to investigate and make orders regarding the pressure at which gas, and the voltage at which electricity, shall be distributed.

SEC. 20. *Inspection of meters.*—Upon petition of any person and the payment by such person of a fee of \$1 for each meter, the commission shall cause to be inspected any electric, gas or water meter used in measuring electricity, gas or water supplied to such petitioner. The company supplying electricity, gas or water through such meter shall reimburse the petitioner for said fee if such meter be found to be more than 2 per cent fast in the case of a gas meter, or 4 per cent fast in the case of an electric or water meter, and shall not again use such meter until corrected and approved by the commission. The commission shall cause to be approved every electric, gas or water meter in which the error does not exceed 2 per cent for gas meters or 4 per cent for electric or water meters, and shall cause the same to be stamped with some suitable device and the date of approval. (Public Acts, 1911, chap. 128.)

DELAWARE

SEC. 4. The board shall have general supervision over all public utilities as herein defined, within the limits of the city of Wilmington, and shall have power, after hearing upon notice, by order in writing:

(a) To require every such public utility as herein defined to comply with the laws of the State relating thereto, or with any legally adopted ordinance or regulation of the said city of Wilmington, or with any of the terms of the franchise under which such public utility operates.

(b) To require every such public utility as herein defined to furnish safe and adequate service. (Laws 1911, vol. 26, chap. 206.)

DISTRICT OF COLUMBIA

SEC. 8, PAR. 21. That the commission shall ascertain and fix adequate and serviceable standards for the measurement of quality, pressure, initial voltage or other condition pertaining to the supply of the product or service rendered by any public utility and prescribe reasonable regulations for examining and testing such product or service and for the measurement thereof. It shall establish reasonable rules, regulations, specifications and standards to secure the accuracy of all meters and appliances for measurement and every public utility is required to carry into effect all orders issued by this commission relative thereto.

PAR. 22. That this commission shall provide for the examination and testing of any and all appliances used for the measuring of any product or service of a public utility. Any consumer or user may have any such appliance tested upon payment of the fees fixed by the commission. The commission shall declare and establish reasonable fees to be paid for testing such appliances on the request of the consumer or users, the fee to be paid by the consumer or user at the time of his request, but to be paid by the public utility and repaid to the consumer or user if the appliance be found defective or incorrect to the disadvantage of the consumer or user.

PAR. 23. That the commission may purchase such materials, apparatus, and standard measuring instruments for such examination and tests as it may deem necessary. The commission, its agents, experts, or examiners shall have power to enter upon any premises, occupied by any public utility for the purpose of making the examination and tests provided for in this section, and to set up and use on such premises any apparatus and appliances and occupy reasonable space therefor.

PAR. 55. That the commission shall, within its jurisdiction, * * * examine or investigate the methods employed by such persons and corporations in manufacturing, distributing, and supplying gas or electricity for light, heat, or power, and in transmitting the same, and have power to order such reasonable improvements as will reasonably promote the public interest, preserve the public health, and protect those using such gas or electricity and those employed in the manufacture and distribution thereof or in the manufacture and operation of the works, wires, poles, lines, conduits, ducts, and systems connected therewith, and have power to order reasonable improvements and extensions of the works, wires, poles, lines, conduits, ducts, and other reasonable devices, apparatus, and property of gas corporations and electrical corporations.

Have power * * * to prescribe from time to time the efficiency of the electric supply system, of the current supplied, and of the lamps furnished by the persons or corporations generating and selling electric current, * * * and for the purpose of determining whether the efficiency of the electric supply system of the current supplied and of the lamps furnished conform to the orders issued by the commission. The commission shall have power of its own motion to examine and investigate the plants and methods employed in manufacturing, delivering, and supplying gas or electricity, and shall have access through its members or persons employed and authorized by it to make such examinations and investigations to all parts of the manufacturing plants owned, used, or operated for the manufacture, transmission, or distribution of gas or electricity by any such person or corporation. * * *

PAR. 57. The commission shall appoint inspectors of electric meters, whose duty it shall be, when required by the commission, to inspect, examine, and ascertain the accuracy of any and all electric meters used or intended to be used for measuring and ascertaining the quantity of electric current furnished for light, heat, or power by any person or corporation to or for the use of any person or corporation, and to inspect, examine, and ascertain the accuracy of all apparatus for testing and proving the accuracy of electric meters; and when found to be or made to be correct the inspectors shall stamp or mark all such meters and apparatus with some suitable device, which device shall be recorded in the office of the commission. No corporation or person shall furnish, set, or put in use any electric meter the type of which shall not have been approved by the commission or any meter not approved by an inspector of the commission.

Every gas corporation and electrical corporation shall provide, repair, and maintain such suitable premises and apparatus and facilities as may be required and approved by the commission for testing and proving the accuracy of gas and electric meters furnished for use by it and by which apparatus every meter may be tested.

If any consumer to whom a meter has been furnished shall request the commission in writing to inspect such meter, the commission shall have the same inspected and

tested; if the same on being so tested shall be found to be more than 4 per cent, if an electric meter, or more than 2 per cent if a gas meter, defective or incorrect to the prejudice of the consumer, the inspector shall order the gas or electrical corporation forthwith to remove the same and to place instead a correct meter, and the expense of such inspection and test shall be borne by the corporation; if the same, on being so tested, shall be found to be correct, the expense of such inspection and test shall be borne by the consumer.

The commission shall prescribe such rules and regulations to carry into effect the provisions of this paragraph as it may deem necessary, and shall fix uniform reasonable charges for the inspection and testing of meters upon complaint. (Public—No. 435. H. R. 28499. Approved, March 4, 1913.)

GEORGIA

SEC. 6. The Railroad Commission of Georgia shall have and exercise all the power and authority heretofore conferred upon it by law, and shall have the general supervision of * * * all gas or electric light and power companies within this State; and while it may hear complaints, yet the commission is authorized to perform the duties imposed upon it of its own initiative, and to require all common carriers and other public-service companies under their supervision to establish and maintain such public service and facilities as may be reasonable and just, either by general rules or by special orders in particular cases. * * * (Georgia Code, 1911, sec. 2663.)

IDAHO

SEC. 33. (a) The commission shall prescribe rules and regulations for the performance of any service or the furnishing of any commodity of the character furnished or supplied by any public utility, and, on proper demand and tender of rates, such public utility shall furnish such commodity or render such service within the time and upon the conditions provided in such rules.

SEC. 44. (b) The commission shall have power, after hearing had upon its own motion or upon complaint, to ascertain and fix just and reasonable standards, classifications, regulations, practices, measurements, or service to be furnished, imposed, observed, and followed by all electrical, gas, and water corporations; to ascertain and fix adequate and serviceable standards for the measurement of quantity, quality, pressure, initial voltage, or other condition pertaining to the supply of the product, commodity, or service furnished or rendered by any such public utility; to prescribe reasonable regulations for the examination and testing of such product, commodity, or service and for the measurement thereof; to establish reasonable rules, regulations, specifications, and standards to secure the accuracy of all meters and appliances for measurement; and to provide for the examination and testing of any and all appliances used for the measurement of any product, commodity, or service of any such public utility.

(c) Any consumer or user of any product, commodity, or service of a public utility may have any appliance used in the measurement thereof tested upon paying the fees fixed by the commission. The commission shall establish and fix reasonable fees to be paid for testing such appliances on the request of the consumer or user, the fee to be paid by the consumer or user at the time of his request, but to be paid by the public utility and repaid to the consumer or user if the appliance is found defective or incorrect to the disadvantage of the consumer or user under such rules and regulations as may be prescribed by the commission. (House Bill No. 21, Laws, 1913.)

ILLINOIS

SEC. 54. *Standards for Service.*—The commission shall have power to ascertain, determine, and fix for each kind of public utility suitable and convenient standard commercial units of service, product, or commodity, which units shall be lawful units for the purposes of this act; to ascertain, determine, and fix adequate and serviceable

standards for the measurement of quantity, quality, pressure, initial voltage, or other condition pertaining to the performing of its service, or to the furnishing of its product or commodity by any public utility, and to prescribe reasonable regulations for examining, measuring, and testing such service, product, or commodity, and to establish reasonable rules, regulations, specifications, and standards to secure the accuracy of all meters and appliances for examining, measuring, or testing such service, product, or commodity. The commission may purchase such materials, apparatus, and standard measuring instruments as it deems necessary to carry out the provisions of this section.

The commission shall provide for the inspection of the manner in which every public utility conforms to the reasonable regulations prescribed by the commission, for examining, measuring, and testing its service, product, or commodity, and the commission may supplement such inspections by examining, measuring, and testing the service, product, or commodity of any public utility. Any consumer or user may have tested any appliance for examining, measuring, or testing any such service, product, or commodity upon payment of the fees fixed by the commission. The commission shall declare and establish reasonable fees to be paid for examining and testing such appliances on the request of consumers or users, the fee to be paid by the consumer or user at the time of this request, but to be paid by the public utility and repaid to the consumer or user if the measuring appliance be found unreasonably defective or incorrect to the disadvantage of the consumer or user.

SEC. 57. *Safety of Plant, Appliances, etc., Railroad Track, etc.*—The commission shall have power, after a hearing and upon its own motion or upon complaint, by general or special orders, rules or regulations, or otherwise, to require every public utility to maintain and operate its plant, equipment, or other property in such manner as to promote and safeguard the health and safety of its employees, passengers, customers, and the public, and to this end to prescribe, among other things, the installation, use, maintenance, and operation of appropriate safety or other devices or appliances, including interlocking and other protective devices at grade crossings or junctions and block or other systems of signalling, to establish uniform or other standards of equipment, and to require the performance of any other act which the health or safety of its employees, passengers, customers, or the public may demand. (Public Utilities Commission law, 1913.)

INDIANA

SEC. 36. *Standards for Measurement.*—The commission shall ascertain and fix adequate and serviceable standards for the measurement of quality, pressure, initial voltage, or other conditions pertaining to the supply of the product or service rendered by any public utility and prescribe reasonable regulations for examinations and testing of such product or service and for the measurement thereof.

SEC. 37. *Accuracy of Meters, Rules.*—The commission shall establish reasonable rules, regulations, specifications, and standards to secure the accuracy of all meters and appliances for measurements, and every public utility is required to carry into effect all orders issued by the commission relative thereto. Nothing contained in this section shall limit in any manner any powers or authority vested in municipal corporations as provided in section 110.

SEC. 38. *Testing of Appliances.*—The commission shall provide for the examination and testing of any and all appliances used for the measuring of any product or service of a public utility. Any consumer or user may have any such appliance tested upon payment of the fees fixed by the commission. The commission shall declare and establish reasonable fee to be paid for testing such appliances on the request of the consumers or users, the fees to be paid by the consumer or user at the time of his request, but to be paid by the public utility and repaid to the consumer or user if the appliance or rate be found unreasonable, defective, or incorrect to the disadvantage of the consumer or user.

SEC. 39. The commission may purchase such material, apparatus, and standard measuring instruments for such examinations and tests as it may deem necessary.

SEC. 73. *Inadequate Service.*—Whenever, upon investigation made under the provision of this act, the commission shall find any regulations, measurements, practices, acts, or service to be unjust, unreasonable, unwholesome, unsanitary, unsafe, insufficient, preferential, unjustly discriminatory, or otherwise in violation of any of the provisions of this act; or shall find that any service is inadequate or that any service which can be reasonably demanded can not be obtained, the commission shall determine and declare and by order fix just and reasonable measurements, regulations, acts, practices, or service to be furnished, imposed, observed and followed in the future in lieu of those found to be unjust, unreasonable, unwholesome, unsanitary, unsafe, insufficient, preferential, unjustly discriminatory, inadequate, or otherwise in violation of this act, as the case may be, and shall make such other order respecting such measurement, regulation, act, practice, or service as shall be just and reasonable. (Laws 1913, chap. 76.)

KANSAS

SEC. 22. *Units of Measurement.*—The commission may ascertain and prescribe for each kind of public utility governed by the provisions of this act, suitable and convenient standard commercial units of products in service. These shall be lawful for the purpose of this act; it shall prescribe reasonable regulations for examinations and testing of such products or service and for the measurement thereof. It shall establish reasonable rules, regulations, specifications, and standards to secure the accuracy of all meters and appliances for measurements and every public utility is required to carry into effect all orders issued by the commission relative thereto. (Law 1911, chap. 238.)

MAINE

SEC. 41. Upon written complaint made against any public utility by 10 persons, firms, corporations, or associations aggrieved, * * * or that any regulation, measurement, practice, or act of said public utility is in any respect unreasonable, insufficient, or unjustly discriminatory or that any service is inadequate or can not be obtained, the commission being satisfied that the petitioners are responsible and that a hearing is expedient, shall proceed with or without notice, to make an investigation thereof. But no order affecting said rates, tolls, charges, schedules, regulations, measurements, practices, or acts complained of shall be entered by the commission without a formal hearing.

SEC. 44. * * * If upon such public hearing it shall be found that any regulation, measurement, practice, act, or service complained of is unjust, unreasonable, insufficient, or unjustly discriminatory or otherwise in violation of any of the provisions of this act, or if it be found that any service is inadequate or that any reasonable service can not be obtained, the commission shall have power to establish and substitute therefor such other regulations, measurements, practice, service, or acts, and to make such order respecting and such changes in such regulations, measurements, practice, service, and acts as shall be just and reasonable. (Senate No. 453, 1913.)

MARYLAND

SEC. 31¾. Investigate and ascertain from time to time the quality of gas supplied by persons and corporations, examine the methods employed by such persons and corporations in manufacturing, selling, delivering, or supplying gas or electricity for light, heat, or power, and in transmitting the same, and have power to order such improvements as will best promote the public interest, preserve the public health and protect those using such gas or electricity and those employed in the manufacture and distribution thereof, or in the maintenance and operation of the works, wires, poles, lines, conduits, ducts, and systems in connection therewith.

Have power by order to fix from time to time such reasonable standards as it may deem proper for the measurement of the purity of gas and of the illuminating power of gas and of the heating power of gas for lighting, heating, or power purposes, whether natural gas distributed or sold, or gas manufactured, distributed, or sold by persons or gas corporations for such lighting, heating, or power purposes, and to prescribe from time to time the efficiency of the electric supply system, of the current supplied, and of the lamps furnished by the persons or electrical corporations generating and selling electric current, and by order to require said natural or other gas to equal the standards so fixed by it, and to prescribe from time to time the reasonable minimum and maximum pressure at which said natural or other gas shall be delivered by said persons or gas corporations.

The commission shall appoint inspectors of gas and electric meters, whose duty it shall be to inspect, examine, prove, and ascertain the accuracy of any and all meters used or intended to be used for measuring or ascertaining the quantity of illuminating or fuel gas, or natural gas, furnished by any gas corporation to or for the use of any person, and any and all electric meters used or intended to be used for measuring and ascertaining the quantity of electrical current furnished for light, heat, and power, by any electrical corporation to or for the use of any person or persons, and when found to be or made to be correct, the inspector shall stamp or mark all such meters and each of them with some suitable device, which device shall be recorded in the office of the secretary of State.

No corporation or person shall furnish or put into use any gas meter which shall not have been inspected, proved, and sealed, or any electric meter which shall not have been inspected, approved, stamped, or marked by an inspector of the commission. Every gas and electric corporation shall provide and keep in and upon its premises a suitable and proper apparatus, to be approved and stamped or marked by the commission, for testing and proving the accuracy of gas and electric meters furnished by it for use, and by which apparatus every meter may and shall be tested, on the written request of the consumer to whom the same shall be furnished, and in his presence if he desires it.

SEC. 32. That if any consumer to whom a meter has been furnished shall request the commission to inspect such meter, the commission shall have the same inspected and tested; if the same, on being tested, shall be found to be 4 per cent if an electric meter, or 2 per cent if a gas meter, defective or incorrect, to the prejudice of the consumer, the inspector shall order the gas or electrical corporation forthwith to remove the same and to place instead thereof a correct meter, and the expense of such inspection and test shall be borne by the corporation; if the same on being so tested shall be found to be correct, the expense of such inspection and test shall be borne by the consumer. A uniform reasonable charge shall be fixed by the commission for this service. (Act of 1910, Chap. 180. Amended 1912 and 1914.)

MASSACHUSETTS

SEC. 188. *Customer to Be Given Meter Reading.*—When a gas or electric meter in a building owned or used by a customer of a gas or electric company is read by an employee or agent of such company, he shall, upon request, deliver to the person using the gas or electricity measured by the meter a written statement of the amount recorded by the meter at that time.

SEC. 189. *Electric Meters to Register Plainly.*—Meters for measuring electricity for lighting purposes supplied to consumers shall register the quantity of electricity passing through them in kilowatt hours, so that the number of kilowatt hours consumed can easily be ascertained by the consumer. No charge shall be made by any person, partnership, or corporation furnishing electricity for lighting purposes for the use of a meter during any portion of 12 consecutive months, if the consumer during that time uses electricity to the value of \$9, and whoever makes a charge therefor

contrary to the provisions hereof shall be punished by a fine not exceeding \$100 for each offense.

SEC. 190. *Testing Electric Meters in Use.*—A customer of a corporation which is subject to the provisions of this act, or such corporation, may apply to the board for an examination and test of any electric meter, demand indicator, so-called, and any other device or appliance installed by such corporation upon a customer's premises and used by such corporation for the purpose of determining the charge to the customer for its service. The board shall forthwith cause such examination and test as in its judgment is practicable and reasonable to be made by a competent and disinterested person, and shall furnish to the corporation and to the customer a certificate of the result and expense thereof. If, upon such examination and test, it appears that the meter does not register correctly, the board may order the corporation to correct or remove such meter, demand indicator, or other device or appliance and to substitute a correct meter, demand indicator, or other device or appliance therefor. All fees for examinations and tests shall in the first instance be paid by the person or corporation making application therefor; but if the examination or test is made at the request of a customer, and the meter is found to be incorrect because too fast, the corporation shall pay such fees to the board, to be repaid by it to the applicant. A meter shall be deemed correct for the purposes of this section if it appears from such examination or test that it does not vary more than 5 per cent from the standard approved by the board. Nothing herein contained shall be held to authorize or prohibit differential prices for electricity supplied by any such company.

SEC. 191. *Inspector of Electric Meters.*—The person designated to make such examination and test may at any reasonable time enter upon the premises where the meter to be inspected is placed for the purpose of making the inspection. He shall receive such compensation for his services as the board may determine, together with his necessary traveling and other expenses, which shall be audited by the board and paid from the treasury of the Commonwealth; but the total amount of compensation and expenses shall not exceed \$3,000 in any year; and if the total amount of such compensation and expenses shall in any year exceed the amount of the fees received for such examination and tests, the excess shall be assessed and recovered from the electric companies in the manner now provided for the assessment and recovery of the other expenses of the board. All money received for fees for such examinations and tests shall be paid into the treasury of the Commonwealth monthly upon the last business day of each month. The board may establish such rules and regulations, fix such standards, prescribe such fees, and employ such means and methods in, and in connection with, such examinations and tests of electric meters as in its judgment shall be most practicable, expedient, and economical. The board may purchase such materials, apparatus, and standard measuring instruments for such examinations and tests as it may deem necessary.

SEC. 192. *Penalty for Use of Incorrect Electric Meter, etc.*—Whoever, being engaged in the sale of electricity, maintains, upon the premises of a customer for the purpose of determining the charge to be made for electricity supplied to him a meter, demand indicator, or other mechanical device or appliance which is found upon examination and test, as provided in section 190, to register incorrectly as against such customer, shall refund to him such an amount as, if not agreed upon, shall, upon application of the customer and after opportunity given to the vendor to be heard, be determined by the board.

SEC. 193. *Use of Prepayment Meters Regulated.*—All gas and electric companies using prepayment meters shall be responsible for the loss by fire of any money deposited in said meters.

SEC. 194. *Gas or Electricity May Be Shut Off, When.*—A gas or electric company may stop gas or electricity from entering the premises of any person who neglects or refuses to pay the amount due therefor or for the use of the meter or other article hired by

him from such company; and, for such purpose, the officers, servants, or workmen thereof may, after 24 hours' notice, enter his premises between the hours of 8 in the forenoon and 4 in the afternoon and separate and take away such meter or other property of the company, and may disconnect any meter, pipe, wires, fittings, or other works, whether they are the property of the company or not, from its mains, pipes, or wires.

SEC. 195. *Refusal of supply, restricted.*—A gas or electric company shall not refuse to supply gas or electricity for any building or premises to a person applying therefor who is not in arrears to it for any gas or electricity previously supplied to him, because a bill for gas or electricity remains unpaid by a previous occupant of such building or premises.

SEC. 197. *Penalty for Injury to Electric Meter, etc.*—Whoever unlawfully and intentionally injures or destroys, or suffers to be injured or destroyed, any meter, pipe, conduit, wire, line, pole, lamp or other apparatus belonging to a corporation, private or municipal, engaged in the manufacture or sale of electricity, or unlawfully and intentionally prevents an electric meter from duly registering the quantity of electricity supplied, or in any way interferes with its proper action or just registration, or, without the consent of such corporation, unlawfully and intentionally diverts any electric current from any wire of such corporation, or otherwise unlawfully and intentionally uses or causes to be used, without the consent of such corporation, any electricity manufactured or distributed by it shall, for every such offense, be punished by a fine of not more than \$100 or by imprisonment for not more than one year, or by both such fine and imprisonment. (Acts of 1914, chap. 742.)

MICHIGAN

SEC. 5. *Power and Duty of Commission.*—The commission shall have power to inspect and examine all such electrical apparatus already installed in any public highways, streets or places, and all such apparatus hereafter installed, and to investigate from time to time the method employed by persons, firms or corporations transmitting and supplying electricity, and shall have power to order such improvements in such method as it shall be necessary to secure good service and the safety of the public and of those employed in the business of transmitting and distributing such electricity, and of any persons liable to be injured by the erection, maintenance and use of such apparatus.

SEC. 6. The commission shall have power in its discretion to order electric current or distribution to be delivered at a suitable primary voltage to any city, village, or township through which a transmission line or lines may pass, * * * and to see that their property is maintained and operated for the security and accommodation of the public and in compliance with the provisions of law. (Public acts, 1909, No. 106.)

MISSOURI

SEC. 69. (3) Have power * * * to prescribe from time to time the efficiency of the electric supply system, of the current supplied and of the lamps furnished by the persons, corporations or municipalities generating and selling electric current * * * for the purpose of determining whether the efficiency of the electric supply system * * * conforms to the orders issued by the commission, the commission shall have power, of its own motion, to examine and investigate the plants and methods employed in manufacturing, delivering, and supplying gas, electricity or water.

SEC. 71. (3) The commission shall appoint inspectors of electric meters whose duty it shall be, when required by the commission to inspect, examine, and ascertain the accuracy of any and all electric meters used or intended to be used for measuring and ascertaining the quantity of electric current used for light, heat, or power by any person, corporation or municipality to or for the use of any person or corporation, and to inspect, examine, and ascertain the accuracy of all apparatus for testing and

proving the accuracy of electric meters, and when found to be, or made to be correct, the inspector shall stamp or mark all such meters and apparatus with some suitable device, which device shall be recorded in the secretary of state. No corporation, person or municipality shall furnish, set, or put in use any electric meter the type of which shall not have been approved by the commission.

4. Every gas corporation, electrical corporation, water corporation and municipality shall provide, repair, and maintain such suitable premises and apparatus and facilities as may be required and approved by the commission for testing and proving the accuracy of gas, water, and electric meters, furnished for use by it, and by which apparatus every meter may be tested.

5. If any consumer to whom a meter has been furnished shall request the commission in writing to inspect such meter, the commission shall have the same inspected and tested; if the same upon being so tested shall be found to be more than 4 per cent if an electric meter, more than 2 per cent if a gas meter, and more than 5 per cent if a water meter, defective or incorrect to the prejudice of the consumer, the expense of such inspection and test shall be borne by the corporation or municipality; if the same on being so tested shall be found to be correct within the limits of error prescribed by the provisions of this subsection, the expense of such inspection and test shall be borne by the consumer.

6. The commission may prescribe such rules and regulations to carry into effect the provisions of this section as it may deem necessary, and shall fix uniform reasonable charges for the inspection and testing of meters upon complaint. (Laws, 1913, P. S. Com. law.)

MONTANA

SEC. 5. Every public utility is required to furnish reasonably adequate service and facilities. * * *

SEC. 10. (a) The commission shall ascertain and prescribe for each kind of public utility, suitable and convenient commercial units of product or service; these shall be lawful units for the purposes of this act.

(b) The commission shall ascertain and fix adequate and serviceable standards for the measurement of quality, pressure, initial voltage, or other conditions pertaining to the supply of the product or service rendered by any public utility and prescribe reasonable regulations for examination and testing of such product or service and for the measurement thereof.

(c) The commission shall provide for the examination and testing of any and all appliances used for the measuring of any product or service of a public utility. Any consumer or user may have any such appliance tested upon payment of the fees fixed by the commission. The commission shall declare and establish reasonable fees to be paid for testing such appliances on the request of the consumers or users, the fee to be paid by the consumer or user at the time of his request, which fees, however, shall be paid by the public utility and repaid to the complaining party, if the quality or quantity of the product or character of the service be found by the commission defective or insufficient in a degree to justify the demand for testing, or the commission may apportion the fees between the parties as justice may require.

(d) The commission may in its discretion, purchase such materials, apparatus, and standard measuring instruments for such examinations and tests as it may deem necessary. (Session Laws, 1913, chap. 52.)

NEVADA

SEC. 10. *Commission to Fix Standards for Service.*—The commission shall ascertain and prescribe for each kind of public utility adequate, convenient, and serviceable standards for the measurement of quality, pressure, voltage, or other conditions pertaining to the supply of the product or service rendered by any public utility, and prescribe reasonable regulations for the examination and testing of such products or

service and for the measurement thereof. Any consumer, user, or party served may have the quality or quantity of the product or the character of any service rendered by any public utility tested upon the payment of fees fixed by the commission, which fees, however, shall be paid by the public utility and repaid to the complaining party if the quality or quantity of the product or the character of the service be found by the commission defective or insufficient in a degree to justify the demand for testing; or the commission may apportion the fees between the parties as justice may require.

Commission May Procure Testing or Measuring Apparatus.—The commission may, in its discretion, purchase such materials, apparatus, and standard measuring instruments for such examinations as it may deem necessary. * * * (Laws 1911, P. S. Com. law.)

NEW HAMPSHIRE

SEC. 5. (c) Said commission shall likewise have power to investigate and ascertain from time to time, the quality of gas supplied by public utilities and methods employed by such public utilities in manufacturing or supplying gas or electricity for light, heat, or power, or in transmitting telephone or telegraph messages, or supplying water, and after notice and hearing thereon shall have power to order all reasonable and just improvements and extensions in service or methods. (Public Acts, 1911, chap. 164.)

SEC. 1. (a) The public-service commission may ascertain, determine, and fix for each kind of public utility suitable and convenient standard commercial units of service, product or commodity, which units shall be lawful units for the purposes of this act.

(b) The commission may ascertain, determine, and fix adequate and serviceable standards for the measurement of quality, pressure, initial voltage, or other conditions pertaining to the performing of its service or to the furnishing of its product or commodity by any public utility, and prescribe reasonable regulations for examination and testing of such service, product, or commodity, and for the measurement thereof.

(c) The commission may ascertain, determine, and fix reasonable rules, regulations, specifications, and standards to secure the accuracy of all meters and appliances for measurement, and every public utility is required to carry into effect all orders issued by the commission relative thereto.

(d) The commission may provide for the inspection of the manner in which every public utility conforms to the reasonable regulations prescribed by the commission for examination and testing of its service, product, or commodity, and for the measurement thereof, and the commission may supplement such inspections by examinations and testing of the service, product or commodity of any public utility, and by the measurement thereof.

(e) The commission may provide for the inspection of the manner in which every public utility has carried into effect the reasonable rules, regulations, specifications, and standards fixed by orders of the commission relative thereto, and the commission may examine and test any and all meters and appliances for measurements under such reasonable rules and regulations as it may prescribe.

(f) The commission may provide for the examination and testing of any and all appliances used for the measuring of any service, product, or commodity of a public utility. Any consumer or user may have any such appliance tested by the commission. The commission may declare and establish reasonable fees to be paid for examining and testing such appliances on the request of consumers or users, the fee to be paid by the consumer or user at the time of his request, but, if the measuring appliance be found unreasonably defective or incorrect to the disadvantage of the consumer or user, the commission shall repay such fee to the consumer or user and collect the same from the public utility.

(g) The commission may purchase such materials, apparatus, and standard measuring instruments for such examinations and tests and for the calibration and standardization of the measuring instruments used by any public utility as it may deem necessary.

SEC. 2. The commission shall fix and collect reasonable fees for examining and testing meters and other measuring apparatus and appliances and the product of any public utility offered to the public for use or consumption, and such fees shall be paid by such public utility owning the same, or offering the same to the public, except in the cases provided for in paragraph (f) of section 1. All fees so collected shall be paid at least once each month into the State treasury, with an itemized statement of the same, and shall, without further legislative act, stand appropriated for use by the commission for the payment of experts, clerks, and assistants.

SEC. 3. This act shall take effect upon its passage. (Public Acts, 1913, chap. 124.)

NEW JERSEY

SEC. 16. The board shall have power: (e) After hearing, by order in writing, to fix just and reasonable standards, classifications, regulations, practices, measurements or service to be furnished, imposed, observed, and followed thereafter by any public utility as herein defined; (f) after hearing, by order in writing, to ascertain and fix adequate and serviceable standards for the measurement of quantity, quality, pressure, initial voltage or other condition pertaining to the supply of the product or service rendered by any public utility as herein defined, and to prescribe reasonable regulations for examination and test of such product or service and for the measurement thereof; (g) after hearing, by order in writing, to establish reasonable rules, regulations, specifications and standards to secure the accuracy of all meters and appliances for measurements; (h) to provide for the examination and test of any and all appliances used for the measuring of any product or service of a public utility as herein defined; (j) to fix the fees to be paid by any consumer or user of any product or service of a public utility as herein defined, who may apply to said board for such examination or test to be made, and any consumer or user may have any such appliance tested upon the payment of the fees fixed by the board, which fees shall be repaid to the consumer or user if the appliance be found defective or incorrect to the disadvantage of the consumer or user and in that event paid by the public utility. (Laws, 1911, chap. 195.)

NEW YORK

SEC. 66. (2) The commission shall investigate and ascertain from time to time, the quality of gas supplied by persons and corporations, examine or investigate the methods employed by such persons and corporations in manufacturing, distributing and supplying gas or electricity for light, heat or power and in transmitting the same and may order such reasonable improvements as will best promote the public interest, preserve the public health and protect those using such gas or electricity and those employed in the manufacture and distribution thereof; and have power to order reasonable improvements and extensions of the works, wires, poles, conduits, ducts and other reasonable devices, apparatus and property of gas corporations, electrical corporations and municipalities.

(3) Have power by order * * * to prescribe from time to time the efficiency of the electric supply system, of the current supplied and of the lamps furnished by the persons, corporations or municipalities generating and selling electric current * * * and for the purpose of determining whether the efficiency of the electric supply system, of the current supplied and of the lamps furnished conforms to the orders issued by the commission, the commission shall have power of its own motion to examine and investigate the plants and methods employed in manufacturing, delivering and supplying gas or electricity.

SEC. 67. (3) Each commission shall appoint inspectors of electric meters whose duty it shall be, when required by the commission, to inspect, examine, and ascertain the accuracy of any and all electric meters used or intended to be used for measuring and ascertaining the quantity of electric current furnished for light, heat or power by any person, corporation or municipality, to or for the use of any person or corpora-

tion, and to inspect, examine, and ascertain the accuracy of apparatus for testing and proving the accuracy of electric meters and when found to be or made to be correct the inspector shall stamp or mark all such meters and apparatus with some suitable device, which device shall be recorded in the office of the secretary of state. No person, corporation or municipality shall furnish, set or put in use any electric meter the type of which shall not have been approved by the commission.

(4) Every gas corporation, electrical corporation and municipality shall provide, repair and maintain such suitable premises and apparatus and facilities as may be required and approved by the commission for testing and proving the accuracy of gas and electric meters furnished for use by it, and by which apparatus every meter may be tested.

(5) If any consumer to whom a meter has been furnished shall request the commission in writing to inspect such meter, the commission shall have the same inspected and tested; if the same on being so tested shall be found to be more than 4 per cent if an electric meter, or more than 2 per cent, if a gas meter, defective or incorrect to the prejudice of the consumer, the expense of such inspection and test shall be borne by the corporation or municipality, if the same on being so tested shall be found to be correct within the limits of error prescribed by the limits of this subdivision, the expense of such inspection and test shall be borne by the consumer.

(6) The commission shall prescribe such rules and regulations to carry into effect the provisions of this section as it may deem necessary, and shall fix uniform reasonable charges for the inspection and testing of meters upon complaint. (Acts 1910, chap. 480.)

NORTH CAROLINA

SEC. 2. That the said commission shall have full power and authority to fix, establish, and regulate the rates or charges of such persons, companies, or corporations, to make such investigations and orders, and establish and enforce rules, regulations, fines, and penalties as it has over railroads.

SEC. 6. The corporation commission shall make reasonable and just rules and regulations: (1) To prevent discrimination in furnishing electricity, electric light, current, power, or gas; (2) to prevent the giving, paying, or receiving of any rebate or bonus, directly or indirectly, or the misleading or deceiving the public in any manner as to real rates or charges for electricity, electric light, current, power, or gas.

SEC. 7. It is the intention of this act to give the said corporation commission the same control, power, and supervision over such persons, companies, and corporations named in this act as it has over railroad corporations in this State. (Chap. 127, Public Laws, session 1913.⁶⁶)

OHIO

SEC. 614-34. The commission shall ascertain and prescribe suitable and convenient standard commercial units of the product or service of any public utility, when the character of its product or service is such that it can be determined, and such units shall be the lawful units for the purposes of this act.

SEC. 614-36. The commission may ascertain and fix adequate and serviceable standards for the measurement of quality, pressure, initial voltage, or other condition pertaining to the supply or quantity of the product or service rendered by any public utility and prescribe reasonable regulations for examination and testing of such product or service and for the measurement thereof. It may establish reasonable rules, regulations, specifications, and standards to secure the accuracy of all meters and appliances for measurements and every public utility is required to carry into effect all orders issued by the commission relative thereto.

⁶⁶ See further the act of Feb. 15, 1909, "An act to provide for the appointment of Inspectors of Electric, Gas, and Water Utilities." An error of $2\frac{1}{2}$ per cent is specified for all kinds of gas, water, and electric meters in this act.

SEC. 614-37. The commission may provide for the examination and testing of any and all appliances used for the measurement of any product or service of a public utility. Any consumer or user may have any such appliance tested upon the payment of the fees fixed by the commission. The commission may declare and establish reasonable fees to be paid for testing such appliances on the request of consumers or users the fees to be paid by the consumer or user at the time the request is made, but to be paid by the public utility and repaid to the consumer or user if the appliance be found to be commercially defective or incorrect to the disadvantage of the consumer or user. (Laws of Ohio, relating to the public utilities commission, 1913.)

OKLAHOMA

SEC. 5. The commission may, from time to time, adopt or promulgate such orders, rules, regulations, or requirements, relative to investigations, inspections, tests, audits, and valuations of the plants and properties relative to inspection and tests of meters as in its judgment may be necessary and proper. * * * (House Bill 156, 1913.)

OREGON

SEC. 500. *Units of Product or Service.*—The commission shall ascertain and prescribe for each kind of public utility suitable and convenient standard commercial units of product or service. These shall be lawful units for the purposes of this act.

SEC. 501. *Standards for Measurement, Accurate Appliances.*—The commission shall ascertain and fix adequate and serviceable standards for the measurement of quality, pressure, initial voltage, or other conditions pertaining to the supply of the product or service rendered by any public utility and prescribe reasonable regulations for examination and testing of such product or service and for the measurement thereof. It shall establish reasonable rules, regulations, specifications, and standards to secure the accuracy of all meters and appliances for measurements and every public utility is required to carry into effect all orders issued by the commission relative thereto.

SEC. 502. *Testing of Measuring Appliances.*—The commission shall provide for the examination and testing of any and all appliances used for the measuring of any product or service of a public utility, and may provide by rules that no such appliance shall be installed and used for the measuring of any product or service of any public utility until the same has been examined and tested by the commission and found to be accurate. * * *

The commission may purchase such materials, apparatus, and standard measuring instruments for such examinations and tests as it may deem necessary. (Laws 1911, chap. 279.)

PENNSYLVANIA

ART. II, SEC. 1. (*w*) If a gas corporation, water corporation, or other public-service company, furnishing its service or product upon meter or other similar measurement, or electric corporation, to provide and keep in and upon its premises, suitable and proper apparatus to be approved from time to time and stamped or marked by the commission, for testing and proving the accuracy of gas, water, electric, or other meters furnished by it for use; and by which apparatus every meter may be tested upon the written request of the consumer to whom the same shall be furnished, and in his presence if he shall so desire. If the meter so tested shall be found to be accurate, within such commercially reasonable limits as the commission may, by general or special order, fix for such meters, or class of meters, a reasonable fee, to be fixed by the commission by standing order, sufficient to cover the cost of such test, shall be paid by the consumer requiring such test, but if not so found then the cost thereof shall be borne by the public-service company furnishing said meter.

ART. V, SEC. 1. Said power and authority shall include power to inquire into and regulate the * * * quantity or quality of water, gas, electricity or light, heat or power supplied.

SEC. 2. Whenever the commission shall determine, after hearing, had upon its own motion, or upon complaint, * * * that the service, facilities * * * are unsafe, inadequate, insufficient, unjust, or unreasonable, * * * the commission shall determine, and specify by an order in writing * * * the just, reasonable, safe, adequate, and sufficient service, facilities, rules, regulations, or practices * * *.

SEC. 13. The commission may, after hearing had upon its own motion or upon complaint, establish such standards of facilities and service of public service companies as shall be reasonably necessary for the safety, accommodation, or convenience of its patrons, employees, and the public; and require by an order to be served in the manner hereinafter provided upon every public service company affected thereby, the facilities or service of such public service companies to conform to such standards. The commission shall also have power, after hearing had upon its own motion or upon complaint, to require public service companies to make all such repairs, changes, alterations, additions, extensions, and improvements, in and about their facilities and service, as shall be reasonably necessary and proper for the safety, accommodation, convenience, and service of their patrons, employees, and the public. (Act of July 26, 1913, No. 854.)

RHODE ISLAND

SEC. 22. *Regulation of Service.*—If upon such a hearing and investigation had under the provisions of this act, the commission shall find that any regulation, measurement, practice, act or service of any public utility is unjust, unreasonable, insufficient, preferential, unjustly discriminatory or otherwise in violation of any of the provisions of this act, or that any service of any such public utility is inadequate or that any service which can be reasonably demanded, can not be obtained, the commission shall have power to substitute therefor such other regulations, measurements, practices, service or acts, and to make such order respecting and such changes in such regulations, measurements, practices, service or acts, as shall be just and reasonable.

SEC. 38. *Charges and Service.*—Every public utility is required to furnish safe, reasonable, and adequate services and facilities * * *.

SEC. 45. *Standards of Quality of Products and Service.*—The commission may, after having given any public utility concerned a reasonable notice and an opportunity to be heard, determine and fix by order the standard amount, quality, pressure, initial voltage and character of each kind of product or service to be furnished or rendered by any public utility, and standard condition or conditions pertaining to furnishing or rendering the same, and thereafter the public utility concerns shall furnish and render the same accordingly, but with and subject to the right of appeal given by section 34 hereof.

SEC. 46. *Standard Measurements.*—The commission shall ascertain and fix adequate and serviceable standards for the measurement of the quality, pressure, initial voltage, or other condition pertaining to the supply of the product or service rendered by any public utility and prescribe reasonable regulations for the examination and testing of such product or service and for the measurement thereof. It shall establish reasonable rules, regulations, specifications, and standards to secure accuracy of all meters and appliances for measurement, and every public utility is required to carry into effect all orders issued by the commission relative thereto.

SEC. 47. *Measuring Instruments, Testing, etc.*—The commission shall provide for the examination and testing of any and all appliances used for measuring any product or service of any public utility. Any consumer or user may have any such appliances tested upon payment of the fees fixed by the commission. The commission shall declare and establish reasonable fees to be paid for the testing of such appliances on the request of the consumers or users, the fee to be paid by the consumer or user at the time of his request, but to be paid by the public utility and repaid to the consumer or user if the appliances be found defective or incorrect or to the disadvantage of the con-

sumer or user. A meter shall be deemed correct for the purposes of this section if it appears from such examination or test that it does not vary more than 2 per cent from the standard approved by the commission.

SOUTH CAROLINA

SEC. 1. That there shall be created a public-service commission of three reputable and competent citizens of this State, to be appointed by the governor, by and with the consent of the senate, who shall be authorized to fix and establish in all cities of this State, now or hereafter incorporated under general or special law of this State, maximum rates and charges for the supply of water, gas, or electricity furnished by any person, firm, or corporation to such city and the inhabitants thereof, such rates to be reasonable and just.

SEC. 5. * * * *Provided*, That the provisions of this act shall not apply to the cities of Charleston, Marion, Spartanburg, Sumter, and Union, or the town of Conway. (Acts, 1910, No. 286, approved February 23, 1910.)

VERMONT

SEC. 9. The public-service commission shall have jurisdiction, on due notice, to hear, determine, render judgment, and make orders and decrees * * * in all matters respecting: (1) The purity, quantity, or quality, of any product furnished or sold by any company under supervision, as provided in this act, and may prescribe the equipment for and standard of measurement, pressure, initial voltage of such product. (Acts, 1909, No. 116.)

VIRGINIA

1.—(b) It shall be the public duty of every public utility to furnish reasonably adequate service and facilities at reasonable and just rates to any person, firm, or corporation along its lines desiring same and not engaged in a similar business, and to charge uniformly therefor all persons or corporations using such product under like conditions, and not in competition with such furnishing company.

But nothing herein contained shall be construed as applicable to schedules of rates or contracts for service rendered by any such company to any municipal corporation or to the State or Federal Government.

2. *Public Utility Defined*.—The term "public utility" as used in this act shall mean and embrace every corporation other than a municipality, company, individual, or association of individuals, their lessees, trustees, or receivers appointed by any court whatsoever that now or hereafter may own, operate, manage, or control any plant or equipment or any part of a plant or equipment within the State for the conveyance of telephone messages or for the production, transmission, delivery, or furnishing of heat, light, water, or power either directly or indirectly to or for the public.

3. *Service Defined*.—The term "service" is used in this act in its broadest and most inclusive sense, and includes not only the use of accommodations afforded consumers or patrons but also any product or commodity furnished by any public utility and equipment, apparatus, appliances, and facilities devoted to the purposes in which such public utility is engaged and to the use and accommodation of the public.

5. *Tests and Equipment Therefor*.—That the State corporation commission may purchase such materials, apparatus, and standard measuring instruments for such examinations and tests as it may deem necessary, and may provide for the examination and testing of the service or any part thereof of any public utility in this State at such time and under such circumstances as the State corporation commission may deem best.

6. *Report by Utilities; Items*.—The State corporation commission, with or without an investigation, may require any public utility to furnish to the said State corporation commission in such form, at such times, and in such detail as the commission shall

require, such accounts, reports, and other information of whatsoever kind or character as said State corporation commission may deem proper and in such form and detail as it may prescribe, in order to show completely the entire operation of the public utility in furnishing the unit of its product or service to the public.

The State corporation commission shall ascertain and prescribe for each kind of public utility suitable standard commercial units of products or service. These shall be lawful units for the purposes of this act.

7. * * * If upon investigation it shall be found that any regulation, measurement, practice, act, or service of any public utility operating in this State complained of is unjust, unreasonable, insufficient, preferential, unjustly discriminatory, or otherwise in violation of any of the provisions of this act, or if it be found that any service is inadequate or that any reasonable service can not be obtained, the State corporation commission shall have power to substitute therefor such other regulations, measurements, practices, service, or acts and to make such order respecting and such changes in such regulations, measurements, practices, service, or acts as shall be just and reasonable. (Chap. 340. Approved Mar. 27, 1914.)

WASHINGTON

SEC. 26. *Duties of Gas, Electrical, and Water Companies.*—Every gas company, electrical company, and water company shall furnish and supply such service, instrumentalities, and facilities as shall be safe, adequate, and efficient and in all respects just and reasonable.

All rules and regulations issued by any gas company, electrical company, or water company, affecting or pertaining to the sale or distribution of its products, shall be just and reasonable.

SEC. 74. *Inspectors of Gas, Electric, and Water Meters.*—The commission may appoint inspectors of electric meters, whose duty it shall be when required by the commission to inspect, examine, prove, and ascertain the accuracy of any and all electric meters used or intended to be used for measuring and ascertaining the quantity of electrical current furnished for light, heat, or power by any public-service company to or for the use of any person or corporation, and to inspect, examine, and ascertain the accuracy of all apparatus for testing and proving the accuracy of electric meters, and when found to be or made to be correct the inspector shall stamp or mark all such meters and apparatus with some suitable device to be prescribed by the commission. No public-service company shall furnish, set, or put in use any electric meters, the type of which shall not have been approved by the commission.

Every gas company, electrical company, and water company shall prepare and maintain such suitable premises, apparatus, and facilities as may be required and approved by the commission for testing and proving the accuracy of gas, electric, or water meters furnished for use by it, by which apparatus every meter may be tested.

If any customer to whom a meter has been furnished shall request the commission in writing to inspect such meter, the commission shall have the same inspected and tested, and if the same on being so tested shall be found to be more than 4 per cent if an electric meter, or more than 2 per cent if a gas meter, or more than 2 per cent if a water meter, defective or incorrect to the prejudice of the consumer, the expense of such inspection and test shall be borne by the gas company, electrical company, or water company, and if the same on being so tested shall be found to be correct within the limits of error prescribed by the provisions of this section, the expense of such inspection and test shall be borne by the consumer.

The commission shall prescribe such rules and regulations to carry into effect the provisions of this section as it may deem necessary, and shall fix the uniform and reasonable charges for this inspection and testing of meters upon complaint. (Laws of 1911, chap. 117.)

WEST VIRGINIA

SEC. 10. The commission shall have general supervision of all persons, firms, or corporations having authority under any charter or franchise of any city, town or municipality, county court or tribunal in lieu thereof, or otherwise, to lay down and maintain wires, pipes, conduits, ducts, or other fixtures in, over, or under streets, highways, or public places for the purpose of furnishing and transmitting electricity for light, heat, or power, or maintaining underground conduits or ducts for electrical conductors, or for telegraph or telephone purposes, and for the purpose of furnishing water, either for domestic or power purposes, and of oil and gas pipe lines.

The commission may ascertain the quantity, healthfulness, and quantity of the water or quality and quantity of gas or electricity supplied by such persons, firms, or corporations, and examine the methods employed, and shall have power to order such improvements as will best promote the public interests and preserve the public health.

The commission shall have power, through its members, inspectors, or employees to enter in, upon, and to inspect the property, buildings, plants, fixtures, power houses, and offices of any such persons, firms, corporations, or municipalities, and shall have power to examine the books and affairs to be investigated by it, and shall have the power, either as a commission or by any of its members, to subpoena witnesses and take testimony and administer oaths to any witness in any proceeding or examination instituted before it or conducted by it in reference to any matter within its jurisdiction. The commission shall, when and as necessary, appoint inspectors of gas, electric, and water meters, whose duty shall be when required to inspect, examine, prove, and ascertain the accuracy of any gas, electric, or water meters used or intended to be used for measuring or ascertaining the quantity of gas, electricity, or water furnished to, by, or for the use of any person, firm, or corporation, and when found to be correct, or made so, the inspector shall stamp or mark each of such meters with some suitable device, which device shall be recorded in the office of the commission. No person, firm, or corporation shall furnish or put in use any gas, electric, or water meter which shall not have been inspected, proved, and stamped or marked by an inspector of the commission. *Provided*, that in case of emergency gas, electric, or water meters may be installed and used before being inspected, but notice thereof shall be immediately given to the public-service commission by the public-service corporation installing the same, and such meters shall be inspected, proved, and stamped or marked, as soon thereafter as practicable. Every gas, electric, and water company or corporation shall provide and keep in and upon its premises suitable and proper apparatus, to be approved and stamped or marked by the commission, for testing and proving the accuracy of gas, electric, and water meters furnished for use by it and by which apparatus every meter may and shall be tested on the written request of the consumer to whom the same shall be furnished, and in his presence if he so desires.

If any person, firm, or corporation to or by whom a meter has been furnished shall request the commission in writing to inspect such meter, the commission shall have the same inspected and tested. If the same on being tested shall be found to be 2 per cent from being correct, or to the prejudice of the user, the inspector shall order the owner of such meter forthwith to remove the same and to place instead thereof a correct meter, and the expense of such inspecting and testing shall be borne by the owner. If the meter, on being so tested, shall be found to be correct, or within 2 per cent of being correct, as above provided, the expense of such inspection and testing shall be borne by the user. A uniform charge and rule shall be fixed by the commission for this service.

Provided, that nothing in this act shall prevent the commission from changing and modifying the method of inspecting meters and adopting such rules and regulations therefor as to the commission may seem just and proper. (Acts of 1915.)

WISCONSIN

SEC. 1797, m. 23. *Standard Measurements, Accurate Appliances.*—1. The commission shall ascertain and fix adequate and serviceable standards for the measurement of quality, pressure, initial voltage, or other conditions pertaining to the supply of the product or service rendered by any public utility and prescribe reasonable regulations for examination and testing of such product or service and for the measurement thereof.

2. It shall establish reasonable rules, regulations, specifications, and standards to secure the accuracy of all meters and appliances for measurements, and every public utility is required to carry into effect all orders issued by the commission relative thereto.

SEC. 1797, m. 24. *Measuring Instruments, Testing, Fees.*—1. The commission shall provide for the examination and testing of any and all appliances used for the measuring of any product or service of a public utility.

2. Any consumer or user may have any such appliance tested upon payment of the fees fixed by the commission.

3. The commission shall declare and establish reasonable fees to be paid for testing such appliances on the request of the consumers or users, the fee to be paid by the consumer or user at the time of his request, but to be paid by the public utility and repaid to the consumer or user if the appliance be found defective or incorrect to the disadvantage of the consumer or user.

SEC. 1797, m. 25. *Public Equipment for Tests.*—The commission may purchase such materials, apparatus, and standard measuring instruments for such examinations and tests as it may deem necessary. (Laws of 1907, chap. 499.)

WYOMING

SEC. 38. *Service Adequate.*—The service and facilities of every public utility shall be adequate and safe and every service regulation shall be just and reasonable. It shall be unlawful for any public utility to make or permit to exist any unjust discrimination or undue preference with respect to its service, facilities, or service regulations.

SEC. 40. *Equipment Adequate—Safety—Crossings.*—All instrumentalities, equipment, plant, and facilities furnished, employed, or used by any public utility, shall in all respect be adequate and efficient, and the construction, operation, and use thereof, shall be such as shall prevent injury to property, and as shall promote the safety, health, comfort, and convenience of its patrons, employees, and the public, and to this end the commission may make rules and regulations governing the overhead construction of telephone, telegraph, trolley, electric light, and power lines hereafter built within this State. Said commission shall also have the power to direct the manner by which all utilities shall cross public highways and other utilities and by which public highways shall cross the utilities, and to prescribe methods of approach and crossing that shall secure safety to the public. At every such crossing, in case the persons interested do not themselves agree, it shall be the duty of the commission to apportion between the parties, in accordance with justice, the costs and expenses of installing and maintaining such crossings. In case expense is apportioned to be paid by a public highway, the portion so to be paid by such highway shall be paid by the city or town in case the crossing line is within the boundaries of a city or town, and by the county in which the crossing is situated in case the same is not within any city or town.

2. SUMMARY OF LAWS RELATING TO ACCIDENTS AND SAFETY PROVISIONS UNDER THE JURISDICTION OF PUBLIC SERVICE COMMISSIONS

The sections of laws here quoted are taken from the public-service commission laws of the various States as listed on pages 202-205.

The laws of certain States referring only to accidents on railroads and street railways are omitted, the purpose of this section being to show the jurisdiction of the public-service commissions with reference to general safety, investigations, and reports of accidents in the operation of gas and electric utilities.

ARIZONA

SEC. 42. The commission shall have power, after a hearing had upon its own motion or upon complaint, by general or special orders, rules, or regulations, or otherwise, to require every public-service corporation to maintain and operate its line, plant, system, equipment, apparatus, tracks, and premises in such manner as to promote and safeguard the health and safety of its employees, passengers, customers, and the public, and to this end to prescribe, among other things, the installation, use, maintenance and operation of appropriate safety or other devices or appliances, including interlocking and other protective devices at grade crossings or junctions and block or other systems of signaling, to establish uniform or other standards of equipment, and to require the performance of any other act which the health or safety of its employees, passengers, customers, or the public may demand.

SEC. 44. The commission shall investigate the cause of all accidents occurring within this State upon the property of any public service corporation or directly or indirectly arising from or connected with its maintenance or operation, resulting in loss of life or injury to persons or property and requiring, in the judgment of the commission, investigation by it, and shall have the power to make such order or recommendation with respect thereto as in its judgment may seem just and reasonable; provided, that neither the order or recommendation of the commission nor any accident report filed with the commission shall be admitted as evidence in any action for damage based on or arising out of the loss of life, or injury to person or property, in this section referred to. Every public service corporation is hereby required to file with the commission, under such rules and regulations as the commission may prescribe, a report of each accident so occurring of such kinds or classes as the commission may from time to time designate.

CALIFORNIA

(The Arizona and California laws are the same.)

COLORADO

SEC. 29. The commission shall have power, after a hearing had upon its own motion or upon complaint, to make general or special orders, rules, or regulations, or otherwise to require every public utility to maintain and operate its line, plant, system, equipment, apparatus, tracks, and premises in such manner as to promote and safeguard the health and safety of its employees, passengers, customers, and the public, and to this end to prescribe, among other things, the installation, use, maintenance, and operation of appropriate safety or other devices or appliances, including interlocking and other protecting devices at grade crossings or junctions and block or other systems

of signaling, to establish uniform or other standards of equipment, and to require the performance of any other act which the health or safety of its employees, passengers, customers, or the public may demand.

CONNECTICUT

PAR. 13. *Duties Relative to Safety of Public and Employees.*—The commission shall so far as is practicable, keep fully informed as to the condition of the plant, equipment, and manner of operation of all public service companies, in so far as the safety of the public and of the employees of such companies may be involved, and may order such reasonable repairs or alterations in such plant or equipment, or such changes in the manner of operation, as may be reasonably necessary for public safety or for the health or safety of said employees.

PAR. 14. *Complaints as to Dangerous Conditions.*—Any person or any town, city, or borough may make complaint, in writing, to the commission, of any defects in any portion of the plant or equipment of any public service company, or of the manner of operating such plant, by reason of which the public safety or the health or safety of employees is endangered; and, if he or it so requests, the name of the complainant shall not be divulged unless in the opinion of the commission the complaint is such that publicity is demanded.

PAR. 17. *Companies to Report Accidents.*—Every public service company shall, in the event of any accident, attended with personal injury or involving public safety, which was or may have been connected with or due to the operation of its plant or equipment, or caused by contact with its wires, notify the commission thereof, by telephone or otherwise, as soon as may be reasonably possible after the occurrence of such accident. If said notice be given otherwise than in writing it shall be confirmed in writing within five days after the occurrence of such accident. Any company failing to comply with the provisions of this section shall be fined not more than \$500 for each offense.

PAR. 18. *Duties of Commission as to Accidents.*—The commission shall examine into the causes of, and the circumstances connected with, all fatal accidents occurring in the operation of the plant or equipment of any public service company, and such other accidents, whether resulting in personal injury or not, as in its judgment, shall require investigation. The commission shall make a record of the causes, facts, and circumstances of each accident, within one month thereafter, and as a part of said record shall suggest means, if possible, whereby similar accidents may be avoided in the future. Such record shall be open to public inspection at the office of the commission and a copy thereof shall be mailed to the company affected thereby.

DISTRICT OF COLUMBIA

PAR. 89. That every public utility shall, whenever an accident attended with loss of human life or personal injury without loss of human life occurs within the District of Columbia, upon its premises, or directly or indirectly arising from or connected with its maintenance or operation, give immediate notice thereof to the commission. In the event of any such accident, the commission, if it deem the public interest requires it, shall cause an investigation to be made forthwith.

IDAHO

SEC. 42. The commission shall investigate the cause of all accidents occurring within this State upon the property of any public utility or directly or indirectly arising from or connected with its maintenance or operation, resulting in loss of life or injury to person or property and requiring in the judgment of the commission, investigation by it, and shall have the power to make such order or recommendation with respect thereto as in its judgment may seem just and reasonable; Provided, That neither the order or recommendation of the commission, nor any accident report filed with the

commission, shall be admitted as evidence in any action for damages based on or arising out of the loss of life or injury to person or property in this section referred to. Every public utility is hereby required to file with the commission, under such rules and regulations as the commission may prescribe, a report of each accident so occurring of such kinds or classes as the commission may from time to time designate.

ILLINOIS

SEC. 56. *Report and Investigation of Accidents.*—Every public utility shall file with the commission, under such rules and regulations as the commission may prescribe, a report of every accident occurring, or that may occur, to or on its plant, equipment, or other property of such a nature as to endanger the safety, health or property of any person; Provided, that whenever any accident occasions the loss of life or limb to any person, such public utility shall immediately give notice to the commission of the fact by the speediest means of communication, whether telephone, telegraph or post.

The commission shall investigate all accidents occurring within this State upon the property of any public utility or directly or indirectly arising from or connected with its maintenance or operation, resulting in loss of life or injury to person or property and requiring in the judgment of the commission, investigation by it, and shall have the power to make such order or recommendation with respect thereto as in its judgment may seem just and reasonable; Provided, That neither the order or recommendation of the commission nor any accident report filed with the commission shall be admitted in evidence in any action for damages based on or arising out of the loss of life, or injury to person or property in this section referred to.

INDIANA

SEC. 123. *Loss of Life—Notice Given.*—Every public utility shall, whenever an accident attended with loss of human life occurs within this State upon its premises, or directly or indirectly arising from or connected with its maintenance or operation, give immediate notice thereof to the commission. In the event of any such accident, the commission, if it deem the public interest require it, shall cause an investigation to be made forthwith, which investigation shall be held in the locality of the accident, unless, for greater convenience of those concerned, it shall order such investigation to be held at some other place; and said investigation may be adjourned from place to place as may be found necessary and convenient. The commission shall give due notice to the public utility of the time and place of the investigation.

KANSAS

SEC. 32. Every common carrier and every public utility governed by the provisions of this act shall, whenever an accident attended with loss of human life or serious personal injury occurs upon its premises within this State, give immediate notice thereof by telegraph to the commission. In the event of any such accident, the commission, if it deem the public interest requires it, shall cause an investigation to be made forthwith, in connection with the labor commission, as now provided by law, which investigation shall be held in the locality of the accident, unless for greater convenience of those concerned it shall order such investigation to be held at some other place. Said investigation may be adjourned from place to place as may be found necessary and convenient. The commission shall seasonably notify an officer or agent of the public utility or common carrier of the time and place of the investigation.

MAINE

SEC. 33. *Investigation of Accidents.*—In the event of an accident resulting in the loss of human life occurring upon the premises of any public utility, or directly or indirectly arising from or connected with its maintenance or operation, the commis-

sion shall cause an investigation thereof to be made forthwith, and in the event of any such accident resulting in personal injury or damage to property the commission may make such investigation if in its judgment the public interest requires it, which investigation shall be held in the locality of the accident, unless for the greater convenience of those concerned it shall order such investigation to be held at some other place; such investigation may adjourn from place to place as may be found necessary and convenient. The commission shall seasonably notify the public utility of the time and place of the investigation, and such public utility may then be heard; and the commission shall have power to make such order or recommendation with respect thereto as in its judgment may seem just and reasonable. Every public utility is hereby required to file with the commission under such rules and regulations as the commission may prescribe, reports of accidents so occurring, in the manner and form designated by the commission; provided, however, that in case of accidents resulting in loss of human life, such report shall be made immediately by telephone or telegraph followed by a detailed written report; provided, that neither the order nor recommendation of the commission nor any accident report filed with the commission shall be admitted as evidence in any action for damages based on or arising out of the loss of life or injury to person or property in this section referred to. Section 65 of chapter 52 of the Revised Statutes is hereby repealed.

MASSACHUSETTS

SEC. 164. Corporations, persons, and municipalities engaged in the manufacture and sale of gas or electricity shall, within twenty-four hours after every accident caused by the gas or electricity manufactured or supplied by them, whereby an employee or other person is injured, rendered insensible, or killed, report in writing to the board, stating the time, place, and circumstances of the accident and such other facts relative thereto as the board may require. The chief of police of the city or town, and the medical examiner of the district in which such accident occurs shall, in writing, report the same to said board. The chief of police shall so report within twenty-four hours, and the medical examiner within seven days, after he has notice thereof. The members of the board shall personally investigate all cases which require investigation.

MISSOURI

SEC. 116. *Powers of Commission to Require Equipment or Performance of Acts Which the Health or Safety of its Employees or the Public may Demand.*—The commission shall have power, after a hearing had upon its own motion or upon complaint, by general or special orders, rules, or regulations, or otherwise, to require every person, corporation, and public utility to maintain and operate its line, plant, system, equipment, apparatus, tracks and premises in such manner as to promote and safeguard the health and safety of its employees, passengers, customers, and the public, and to this end to prescribe, among other things, the installation, use, maintenance, and operation of appropriate safety and other devices or appliances, including interlocking and other protective devices at grade crossings or junctions and block and other systems or signaling, to establish uniform or other standards of equipment, and to require the performance of any other act which the health or safety of its employees, passengers, customers, or the public may demand.

MONTANA

SEC. 27. The commission or some member thereof or some person deputed by it shall investigate and make inquiry into every accident occurring in the operation of any public utility in this State resulting in death or injury to any person of such gravity as to require the attention of a physician or surgeon. The testimony taken at such hearing shall be transcribed and filed in the office of the commission.

(a) It is hereby made the duty of every public utility operating within this State, promptly upon the occurrence of any accident, such as is mentioned above, to report by telegraph, followed by written report, the same to the commission, in which report shall be stated the time and place of accident, the names of persons killed or injured, and in concise form the nature and cause of such accident. The commission shall prescribe forms for the purpose of making such written reports. Reports of accidents as referred to in this section shall be included in the commission's annual report to the governor.

NEVADA

SEC. 27. *Notice of Serious Accidents to Persons Given Commission.*—Every public utility shall, whenever an accident occurs in the conduct of its operation, causing death or personal injuries, give immediate notice thereof to the commission. If in its judgment the public interest requires it, the commission shall cause an investigation to be made forthwith, at such place and in such manner as the commission shall deem best.

NEW HAMPSHIRE

SEC. 15. The commission shall investigate the causes of all accidents happening upon the railroads of the State resulting in the loss of life and of all other accidents so happening which, in the opinion of the commission, ought to be investigated. Any such investigation may be made by the full commission or by a single commissioner, as the commission may determine. If such investigation is made by a single commissioner, said commissioner for the purposes of the particular investigation shall have and exercise all the powers of the full commission.

NEW JERSEY

SEC. 17. The board shall have power after hearing upon notice by order in writing to require every public utility as herein defined:

(g) To give such notice to the board as the board may by rule require of any and all accidents which may occur within this State upon the property of any public utility as herein defined or directly or indirectly arising from or connected with its maintenance or operation, and to investigate any such accident and to make such order or recommendation with respect thereto as in its judgment may be just and reasonable.

NEW YORK

SEC. 66. *General Powers of Commissions in Respect to Gas and Electricity.*—Each commission shall within its jurisdiction: (2) Investigate and ascertain, from time to time, the quality of gas supplied by persons, corporations, and municipalities; examine or investigate the methods employed by such persons, corporations, and municipalities in manufacturing, distributing, and supplying gas or electricity for light, heat, or power and in transmitting the same; have power to order such reasonable improvements as will best promote the public interest, preserve the public health, and protect those using such gas or electricity and those employed in the manufacture and distribution thereof; and have power to order reasonable improvements and extensions of the works, wires, poles, lines, conduits, ducts, and other reasonable devices, apparatus, and property of gas corporations, electrical corporations, and municipalities.

NORTH CAROLINA

SEC. 7. It is the intention of this act to give the said corporation commission the same control, power, and supervision over such persons, companies, and corporations named in this act as it has over railroad corporations in this State.

OKLAHOMA

SEC. 2. The commission shall have general supervision over all public utilities, with power to fix and establish rates and to prescribe rules, requirements, and regulations affecting their services, operation, and the management and conduct of their business; shall inquire into the management of the business thereof and the method in which same is conducted. It shall have full visitorial and inquisitorial power to examine such public utilities and keep informed as to their general conditions, their capitalization, rates, plants, equipments, apparatus, and other property owned, leased, controlled, or operated, the value of the same, the management, conduct, operation, practices, and services not only with respect to the adequacy, security, and accommodation afforded by their service but also with respect to their compliance with the provisions of this act, and with the constitution and laws of this State, and with the orders of the commission.

OREGON

552. *Investigation of Accidents.*—Every public utility shall, whenever an accident attended with loss of human life occurs within this State upon its premises, or directly or indirectly arises from or connected with its maintenance or operation, give immediate notice thereof to the commission. In the event of any such accident the commission, if it deem the public interest require it, shall cause an investigation to be made forthwith, which investigation shall be held in the locality of the accident unless for greater convenience of those concerned it shall order such investigation to be held at some other place; and said investigation may be adjourned from place to place as may be found necessary and convenient. The commission shall seasonably notify the public utility of the time and place of the investigation.

PENNSYLVANIA

ART. II, SEC. 1. (x) To give immediate notice to said commission of the happening of any accident in or about, or in connection with the operation of its property, facilities or service, wherein any person shall have been killed or injured; and to furnish such full and detailed report of such accident, within such time and in such manner as the commission shall, by general rule or special order, or otherwise, require. Such report shall not be open for public inspection, except by order of the commission, and shall not be admitted in evidence for any purpose in any suit or action for damages growing out of any matter or thing mentioned in said report.

RHODE ISLAND

SEC. 23. *Public Safety.*—If upon such a hearing and investigation the commission shall find that the regulations, practices, acts, plant or equipment, appliances, or service of any public utility, or any condition suffered, permitted, or maintained by any public utility is unsafe or improper, or that the public safety is endangered thereby, the commission shall by order determine the proper regulations, practices, acts, plant or equipment, appliances or service thereafter to be in force and to be observed, maintained, and used by such public utility, and may by order require any dangerous or unsafe condition to be removed or remedied.

SEC. 49. Every public utility shall, whenever any accident attended with loss of human life or serious injury occurs within this State, directly or indirectly arising from or connected with its maintenance or operation, give immediate notice thereof to the commission. In the event of any such accident, the commission, if it deem that public interest requires it, shall cause an investigation to be made forthwith, which investigation shall be held in the locality of the accident, unless for the greater convenience of those concerned it shall order the investigation to be held at some other place; and said investigation may be adjourned from place to place as may be found necessary and convenient. The commission shall seasonably notify the public

utility of the time and place of the investigation. The notice herein required to be given shall not be admitted as evidence or used for any purpose against such public utility giving such notice in any suit, action, or proceeding brought for damages growing out of any matter mentioned in said notice, nor shall such notice be admitted as evidence or be used for any purpose in any criminal proceeding brought against the public utility giving such notice, or against any of its officers, agents, or employees, growing out of any matter mentioned in such notice.

VERMONT

SEC. 7. The superintendent or manager of any line or plant subject to supervision under this act shall immediately after its occurrence notify said commission in writing of any accident within this State upon such line or plant resulting in loss of life or injury to any person which shall incapacitate him from engaging in his usual vocations. Said commission shall inquire into the cause of every such accident, and if in its judgment a public investigation is necessary, it shall fix a time and place of holding the same, and thereupon proceed as provided in section 4609 of the Public Statutes relating to investigation of accidents upon railroads.

WASHINGTON

SEC. 26 [last par.]. Every gas company, electrical company, and water company shall construct and maintain such facilities in connection with the manufacture and distribution of its product as will be efficient and safe to its employees and the public.

SEC. 63. *Investigation of Wrecks.*—Every public service company is hereby required to give immediate notice to the commission of every accident resulting in death or injury to any person occurring on its lines, plant, or system in such manner as the commission may prescribe. The commission may require reports to be made by any common carrier of all wrecks, collisions, or derailments occurring on the line of any such common carrier. Such notice shall not be admitted as evidence or used for any purpose against such public service company giving such notice in any suit or action for damages growing out of any matter mentioned in such notice.

The commission is hereby authorized and directed to investigate all accidents that may occur upon the lines of any common carrier resulting in loss of life to any passenger or employee, and may investigate any and all accidents or wrecks occurring on the line of any such common carrier or any accident resulting in death or injury to any person occurring in connection with the plant or system of any public service company. Notice of such investigation shall be given in all cases for a sufficient length of time to enable the public service company affected to participate in the hearing, and such notice may be given orally or in writing, in such manner as the commission may prescribe.

Such witnesses may be examined as the commission may deem necessary and proper to thoroughly ascertain the cause of the accident or wreck and fix the responsibility therefor. Such examination and investigation may be conducted by the inspector or any deputy inspector, and such inspector or deputy inspector shall have the power to administer oaths, issue subpoenas, and compel the attendance of witnesses, and when such examination is conducted by the inspector or deputy inspector he shall make a full and complete report thereof to the commission.

WISCONSIN

SEC. 1797m—101. 1. Every public utility shall, whenever an accident attended with loss of human life occurs within this State upon its premises or directly or indirectly arising from or connected with its maintenance or operation, give immediate notice thereof to the commission.

2. In the event of any such accident the commission, if it deem public interest require, shall cause an investigation to be made forthwith, which investigation shall be held in the locality of the accident, unless for greater convenience of those concerned it shall order such investigation to be held at some other place; and said investigation may be adjourned from place to place as may be found necessary and convenient. The commission shall seasonably notify the public utility of the time and place of the investigation.

APPENDIX 2

TABLE 1

Maximum Watthour Meter Errors Allowed by Commission Regulations

State	Allowable error	Rule	Page
Arizona.....	3 per cent on light load, half load, or full load.....	13	75
	2 per cent average error.....	E 15	75
Connecticut.....	2 per cent, not in excess of, at heavy load.....		
	4 per cent, not in excess of, at light load.....		
	4 per cent on commission test.....	5	130
District of Columbia.....	4 per cent.....	10	130
Illinois.....	4 per cent average error.....	22, 21	76
Indiana.....	4 per cent on light, half, or full load.....	15	77
	4 per cent on commission test.....	5b	246
Maryland.....	1 per cent adjustment.....	6b	247
	2 per cent in service.....	4a	246
Missouri.....	4 per cent of correct registration.....	31	77
Montana.....	4 per cent between one-tenth and full load.....	11	77
	2 per cent on normal load.....	15	77
Nevada.....	3 per cent on one-tenth rated meter capacity.....		
New Hampshire.....	4 per cent on light, normal, or heavy load.....	2	78
New Jersey.....	4 per cent on light load or heavy load.....	18	78
New York (1st Dist.).....	1 per cent adjustment.....		78
Oregon.....	4 per cent.....	5b	133
Pennsylvania.....	4 per cent average at light and heavy load.....	11, 12	79
Washington.....	4 per cent on one-tenth or full load.....	27	80
West Virginia.....	2 per cent at light load or heavy load.....	11	80
Wisconsin.....	4 per cent between one-tenth and full connected load.....	15	80

TABLE 2

Maximum Watthour Meter Errors Allowed by City Ordinances

City	Allowable error	City	Allowable error
	Per cent		Per cent
Charleston, S. C.....	4	Memphis, Tenn.....	3
Chicago, Ill.....	4	Norfolk, Va.....	4
Cincinnati, Ohio.....	5	Sandusky, Ohio.....	3
Kansas City, Mo.....	2.5	San Francisco, Cal.....	2
Louisville, Ky.....	4	Sioux City, Iowa.....	2
Minneapolis, Minn.....	2.5	Topeka, Kans.....	3

The States listed in the following table fix by statute the allowable meter error. The full text of the section of the statute will be found in Appendix 1.

TABLE 3
Maximum Watthour Meter Error Allowed by Statute

State	Allowable error in meters	Law
	Per cent	
Arizona.....	3	Laws 1912, chap. 52, special session.
Connecticut.....	4	Acts 1911, chap. 128, sec. 20.
District of Columbia.....	4	Public Utility law, par. 57.
Maryland.....	4	Laws 1910, chap. 180, sec. 32.
Massachusetts.....	5	Acts 1914, chap. 742, sec. 190.
Missouri.....	4	Laws 1913, Public Service Commission law, sec. 71(5).
New York.....	4	Laws 1910, chap. 480, sec. 67(5).
North Carolina.....	2½	Act Feb. 15, 1909.
Rhode Island.....	2	Acts 1912, chap. 795, sec. 47.
Washington.....	4	Laws 1911, chap. 117, sec. 74.
West Virginia.....	2	Laws 1915, Public Service Commission law, sec. 10.

TABLE 4
Summary of Results of Periodic Meter Tests by Owning Companies as Reported to New York Public Service Commission, First District

Year	Meters tested	More than 4 per cent fast		More than 4 per cent slow		Between 4 per cent fast and 4 per cent slow		Reference
		Number	Per cent	Number	Per cent	Number	Per cent	
1910....	107 836	2912	2.7	18 012	16.69	86 922	80.61	Report 1910, vol. 1, p. 188
1911....	153 116	2139	1.4	16 251	10.8	134 744	88.0	Report 1911, vol. 1, p. 140
1912....	154 638	1900	1.2	12 809	8.3	139 829	90.5	Report 1912, vol. 1, p. 221

TABLE 5
Summary of Results of Periodic Meter Tests by Owning Companies as reported to New York Public Service Commission, Second District

Year	Meters tested	More than 4 per cent fast		More than 4 per cent slow		Between 4 per cent fast and 4 per cent slow		Reference
		Number	Per cent	Number	Per cent	Number	Per cent	
1909....	78 116	7458	9.5	16 085	20.6	54 573	69.9	Report 1909, vol. 1, p. 46
1910....	84 576	6247	7.4	14 742	17.4	63 578	75.2	Report 1910, vol. 1, p. 34
1911....	87 893	4947	5.6	12 791	14.6	70 155	79.8	Report 1911, vol. 1, p. 37
1912....	97 446	4694	4.8	11 621	12.0	81 131	83.2	Report 1912, vol. 1, p. 19
1913....	104 886	-----	-----	-----	-----	91 176	87.0	Report 1913, vol. 1, p. 88
1914....	122 921	3581	2.9	10 040	8.2	109 300	88.9	Report 1914, vol. 1, p. 21.

TABLE 6

Summary of Results of Meter Tests on Complaint of Customer, Reported by New York Public Service Commission, First District (Tests Made by the Commission)

Year	Meters tested	Found creeping		More than 4 per cent fast		More than 4 per cent slow		Between 4 per cent fast and 4 per cent slow	
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
1908.....	239	.....	.....	32	13.5	28	11.5	179	75.0
1909.....	925	56	6.1	67	7.2	91	9.8	767	82.9
1910.....	637	43	6.7	36	5.7	47	7.4	554	86.9
1911.....	609	26	4.3	33	5.4	28	4.6	548	90.0
1912.....	651	29	4.4	54	8.3	21	3.2	576	88.5
1913.....	568	38	6.7	42	7.4	17	3.1	509	89.5
1914.....	701	53	7.6	24	3.3	17	2.5	660	94.2

Year	Meters tested	Total fast		Total slow		Reference
		Number	Per cent	Number	Per cent	
1908.....	239	122	51	117	49	Report 1908, vol. 1, p. 154
1909.....	925	594	53.4	431	46.6	Report 1909, vol. 1, p. 154
1910.....	637	353	55.4	284	44.6	Report 1910, vol. 1, p. 186
1911.....	609	327	53.7	282	46.3	Report 1911, vol. 1, p. 145
1912.....	651	405	62.2	246	37.8	Report 1912, vol. 1, p. 240
1913.....	568	363	64.0	205	36.0	Report 1913, vol. 1, p. 238
1914.....	701	374	53.3	327	46.7	Report 1914, vol. 1, p. 307

TABLE 7

Showing Improvement in Meter Accuracy, 1902-1910, Obtained by an Operating Company

[Proceedings N. E. L. A., Thirty-fourth Convention, 1911, Vol. 2, p. 225]

Year	Meters in service Dec. 31	Average tenth-load accuracy	Average heavy-load accuracy	Meters tested	Per cent meters tested
		Per cent	Per cent		
1902.....	3490	84.4	92.0	1868	53.5
1903.....	4165	81.5	94.0	2980	71.5
1904.....	4952	84.2	95.1	3556	71.8
1905.....	5861	87.9	96.1	4044	69.0
1906.....	6964	90.3	97.1	4086	58.6
1907.....	8060	93.2	97.5	6942	86.1
1908.....	9276	94.1	98.1	10 558	113.8
1909.....	10 950	95.2	98.4	11 350	103.0
1910.....	14 004	95.9	98.4	14 797	105.6

TABLE 8

Meter Accuracy by Types

[From N. E. L. A. Report, vol. 2, 1911, p. 225]

HEAVY LOAD

Type	Period between tests	Above 104 per cent	96 to 104 per cent	98 to 102 per cent	Below 96 per cent	Not running	Meters tested
	Months	Per cent	Per cent	Per cent	Per cent	Per cent	
Induction.....	12	1.2	97.0	86.0	1.8	0.4	40 000
Commutating 110-220 d. c.....	6	2.0	92.0	71.0	6.0	1.0	6000
500 volt d. c.....	3	10.0	78.5	62.0	11.5	2.5	3000

10 PER CENT LOAD

Induction.....	12	2.5	92.0	78.0	5.5	0.7	40 000
Commutating 110-220 d. c.....	6	6.0	74.5	48.0	19.5	1.5	6000
500 volt d. c.....	3	11.0	63.5	50.0	26.5	3.5	3000

TABLE 9

Estimated Percentage of Meters of Various Sizes on a Typical System (35 000 Meter Basis)

[From proceedings N. E. L. A., thirty-fifth convention, vol. 3, p. 286]

Meters	Per cent
5-ampere.....	58.8
10-ampere.....	20.3
10-25 ampere.....	14.3
25-75 ampere.....	4.0
100 ampere and above.....	2.6
	100.0

TABLE 10

Voltage Regulation Requirements

State	Circuit or contract	Per cent variation	Period	Time	Rule
			Min		
Connecticut.....	Lighting.....	5 per cent above, 3 per cent below	1	Sunset and 11 p. m.	E 6
	Power.....	10 per cent above or below	1	Any time.....	E 6
District of Columbia.....	Lighting.....	3 per cent from standard		During lighting hours	15
		10 per cent from standard		Other hours.....	
	Power.....	do			
Illinois.....	Lighting contract.....	Shall not exceed 5 per cent plus or minus of standard	1	At any time during which service is supplied	26
	Power contract.....	Shall not exceed 10 per cent plus or minus of standard	1		26
Indiana.....	On constant-potential system	Not more than 6 per cent of minimum value		During any one day	23
Maryland.....		6 per cent above and below		Sunset and 11 p. m.	2
	Power.....	8 per cent from standard			
Missouri.....	Lighting.....	3 per cent above, 5 per cent below	1	Sunset and 11 p. m.	27
		5 per cent above, 10 per cent below	1	Between 11 p. m. and following sunset	
	Power.....	10 per cent above and below	1		
Montana.....		As Indiana.....		Between 11 p. m. and following sunset	17
Nevada.....		As Indiana.....		Between 11 p. m. and following sunset	23
New Hampshire.....	Lighting ⁶⁷	5 per cent above and 3 per cent below		During lighting hours	14
	Power ⁶⁷	Within 10 per cent.		do.....	14
	Lighting ⁶⁸	Maximum not more than 10 per cent above minimum		do.....	

⁶⁷ Applicable to utilities selling more than 50 000 kWhrs annually or having more than 50 consumers.⁶⁸ Applicable to all other utilities.

TABLE 10—Continued

State	Circuit or contract	Per cent variation	Period	Time	Rule
			Min		
New Jersey.....	On constant-potential system	Not more than 3 per cent above nor 3 per cent below standard	5	Between sunset and 11 p. m.	6
Oregon ⁶⁶	Lighting	3 per cent above, 5 per cent below.	5	do.....	25
	do.....	5 per cent above, 10 per cent below	5	Between 11 p. m. and the following sunset	
	Other circuits.....	10 per cent above or below	5	do.....	
Pennsylvania.....	Lighting contract..	5 per cent plus or minus	1	Any time during service	2
	Power contract....	10 per cent plus or minus	1	do.....	
West Virginia.....	Lighting.....	5 per cent above, 3 per cent below	1	do.....	24
	Both lighting and power	10 per cent either way	1	do.....	
Wisconsin.....	Lighting.....	Within 3 per cent of standard	do.....	During lighting hours	25
	do.....	Within 10 per cent.	do.....	During other than lighting hours	
	Power.....	do.....	do.....	do.....	
	Service in town of less than 1500 people	Maximum shall not be more than 6 per cent above minimum	do.....	do.....	

⁶⁶ Applicable only in towns of more than 1500 population.

TABLE 11

Commercial and Municipal Central Electric Stations

[From Bulletin 124, Bureau of the Census]

	1912	1907	1902	Per cent increase 1902-1912
Number of stations ⁷⁰	5221	4714	3620	44.2
Commercial.....	3659	3462	2805	30.4
Municipal.....	1562	1252	815	91.7
Total income ⁷¹	\$302 115 599	\$175 642 338	\$85 700 605	252.5
Light, heat, and power, including free service..	\$286 980 858	\$169 614 691	\$84 186 605	240.9
All other sources.....	\$15 134 741	\$6 027 647	\$1 514 000	899.7
Total expenses, including salaries and wages ⁷²	\$234 419 478	\$134 196 911	\$68 081 375	244.3
Total number of persons employed.....	79 335	47 632	30 326	161.6
Total horsepower.....	7 528 648	4 098 188	1 845 048	308.0
Steam engines and steam turbines: ⁷³				
Number.....	7844	8054	6295	24.6
Horsepower.....	4 946 532	2 693 273	1 394 395	254.7
Water wheels:				
Number.....	2933	2481	1390	111.0
Horsepower.....	2 471 081	1 349 087	438 472	463.6
Gas and oil engines:				
Number.....	1116	463	165	576.4
Horsepower.....	111 035	55 828	12 181	811.5
Kilowatt capacity of dynamos.....	5 134 689	2 709 225	1 212 235	323.6
Output of stations in kilowatt hours.....	11 532 963 006	5 862 276 737	2 507 051 115	360.0
Estimated number of lamps wired for service:				
Arc.....	505 395	⁷⁴ 562 795	385 698	31.0
Incandescent and other varieties.....	76 507 142	⁷⁴ 41 876 332	18 194 044	320.5
Stationary motors served:				
Number.....	435 473	167 184	101 064	330.9
Horsepower capacity.....	4 130 619	1 649 026	438 005	843.1

⁷⁰ The term "station," as here used, may represent a single electric station or a number of stations operated under the same ownership.

⁷¹ Exclusive of \$36 500 030 in 1912, \$20 093 302 in 1907, and \$7 703 574 in 1902 reported by street and electric railway companies as income from sale of electric current for light or power or from sale of current to other public-service corporations.

⁷² In addition to salaries and wages, includes the cost of supplies and materials used for ordinary repairs and replacement, advertising, fuel, mechanical power, electrical energy purchased, taxes, and all other expenses incident to operation and maintenance and for 1912 charges for depreciation and charges for sinking fund.

⁷³ Includes auxiliary engines.

⁷⁴ Includes for purposes of comparisons 7082 arc and 267 997 incandescent lamps reported by the electric companies to light their own properties. Lamps used for such service were included in the total number reported in 1912.

TABLE 12
Municipal Central Electric Stations
 [From Bulletin 124, Bureau of the Census]

	1912	1907	1902	Per cent increase 1902-1912
Number of stations.....	1552	1252	815	91.7
Total income.....	\$23 218 989	\$14 011 999	\$6 965 105	233.4
Light, heat, and power, including free service.....	\$22 663 708	\$13 614 434	\$6 836 856	231.5
All other sources.....	\$555 281	\$397 565	\$128 249	333.0
Total expenses, including salaries and wages ⁷⁵	\$16 917 165	\$10 316 620	\$5 245 987	222.5
Total number of persons employed.....	7940	5566	3417	132.4
Total horsepower.....	559 328	321 351	160 028	249.5
Steam engines and steam turbines: ⁷⁶				
Number.....	2024	1786	1096	84.7
Horsepower.....	406 666	284 922	147 853	175.0
Water wheels:				
Number.....	269	153	82	228.0
Horsepower.....	130 261	30 347	11 218	1061.2
Gas and oil engines:				
Number.....	283	78	18	1472.2
Horsepower.....	22 401	6082	957	2240.8
Kilowatt capacity of dynamos.....	368 677	209 016	113 380	225.2
Output of stations in kilowatt hours.....	537 526 730	289 462 788	195 904 439	174.4
Estimated number of lamps wired for service:				
Arc.....	91 851	77 83 535	50 795	80.8
Incandescent and other varieties.....	7 057 849	77 4 089 897	1 577 451	347.4
Stationary motors served:				
Number.....	21 895	4507	1962	1016.0
Horsepower capacity.....	164 291	31 689	3324	4942.6

⁷⁵ In addition to salaries and wages, includes the cost of supplies and materials used for ordinary repairs and replacement, advertising, fuel, mechanical power, electrical energy purchased, taxes, and all other expenses incident to operation and maintenance, and for 1912 charges for depreciation and charges for sinking fund.

⁷⁶ Includes auxiliary engines.

⁷⁷ Includes for purposes of comparison, 595 arc and 28 579 incandescent lamps reported by the electric companies to light their own properties. Lamps used for such service were included in the total number reported in 1902.

APPENDIX 3**STANDARDS, RULES, AND REGULATIONS FOR ELECTRICAL CORPORATIONS IN THE STATE OF MARYLAND**

[Order No. 2599, Jan. 17, 1916. Effective Feb. 1, 1916]

A. APPLICATION OF RULES

The following rules shall apply to all persons, firms, associations or corporations, both private and municipal, now or hereafter engaged as a public utility in the business of furnishing electric energy to domestic or commercial consumers within the State of Maryland, except as hereinafter provided. The adoption of these rules shall in no way preclude the Commission from altering or amending the same, in whole or in part, or from requiring any other or additional service, equipment, facility or standard, either upon complaint or upon its own motion, or upon the application of any utility. And, furthermore, these rules shall not in any way relieve any utility from any of its duties under the laws of this State, except as hereinafter provided.

B. DEFINITIONS

The word "Commission" used in these rules shall be construed to mean the Public Service Commission of Maryland.

The word "consumer" used in these rules shall be construed to mean any person, firm, association or corporation, either private or municipal, supplied with electric energy by any public utility.

The word "utility" used in these rules shall be construed to mean any public utility referred to in the first paragraph (A).

C. INTERRUPTIONS TO SERVICE

Each utility shall keep a record of all interruptions to service upon its entire system, or larger divisions thereof, including a statement as to the time, duration and cause of any such interruption. These records shall be open at all times to the inspection of an authorized representative of the Commission.

D. INSPECTION OF PLANT AND EQUIPMENT

Each utility shall inspect its plant and distributing equipment and facilities in such manner and with such frequency as is in accord with good practice, in order that the same may be maintained in proper condition for use in rendering safe and adequate service.

E. TESTING FACILITIES

1. Each utility shall on or before May 1, 1916, provide, maintain and use one or more portable indicating voltmeters for testing voltage regulation; and each utility serving more than 250 consumers shall in addition, provide, maintain and use one or more portable recording voltmeters giving a continuous record of not less than 24 hours' duration. At least one recording voltmeter shall be kept in continuous operation at the station, or some fixed point on the utility's system within a reasonable distance of the center of distribution. Voltmeter records shall be preserved for inspection at any time by an authorized representative of the Commission.

2. Each utility furnishing metered service shall, on or before April 1, 1916, provide and properly maintain and use the following meter-testing facilities:

(a) Suitable portable testing equipment to be used as working standards for testing service watt-hour meters, switchboard instruments, recording voltmeters and other electrical instruments in use.

(b) Suitable electrical measuring instruments and meters, to be used as reference standards, for testing the accuracy of the portable testing equipment provided for in (a) of this rule. Such reference standards may be of the service type of watthour meters, but if so such watthour meters shall be permanently mounted in the laboratory or the meter shop of the utility and to be used for no other purpose than for checking working standards.

Reference standards of all kinds will be tested, and if practicable, adjusted by the Commission at least once a year.

F. RECORDS OF TESTS OF SERVICE AND OF METERS

1. Each utility shall keep a record of the time of starting and shutting down power station equipment or feeders, together with the readings of the principal switchboard instruments at such intervals as are necessary to indicate the characteristics of the load; together with the time of starting and disconnecting all street lighting circuits. The scope of this record shall show the time, duration, extent and cause of the different operations of the power station and feeders.

2. Each utility shall provide such curve-drawing wattmeters, indicating wattmeters or watthour meters as may be necessary to obtain a daily record of the load and a monthly record of the output of its plants. Each utility purchasing electric energy shall install such indicating wattmeters and watthour meters as may be necessary to furnish full information as to the daily demand and monthly purchases.

3. Whenever any service meter is tested the original test record shall be preserved, indicating the information necessary for identifying the meter, the reason for making the test, and, if removed, the reading of the meter upon removal from service and the result of the test, together with all data taken at the time of the test in sufficiently complete form to permit the convenient checking of the methods employed and the calculations.

4. A record shall also be kept, numerically arranged, indicating for each meter owned or used by any utility the date of purchase, a record of the use, repairs and results of tests to which it has been subjected, and its present location.

5. All records shall be preserved in the office of the utility in the State of Maryland and shall at all times be open to inspection by an authorized representative of the Commission. These records must be preserved for a period of at least 12 months; provided, however, that any utility may report a summary by months of such records to the Commission for each calendar year. After such report has been made and the utility has been advised by the Commission of its receipt, and in the event that no inquiry or investigation is then in progress by the Commission requiring the details of such records, such records as have been so reported by summary and the receipt acknowledged may be disposed of by the utility as may seem best to it.

G. REPORTS TO THE COMMISSION

Each utility shall report to the Commission as and when called upon the results of all tests required to be made, or the information contained in any records required to be kept by the utility.

H. ACCIDENTS

Each utility shall as soon as possible report to the Commission each accident happening in connection with the operation of its property, facilities or service, whereby any person shall have been killed, or injured to the extent of three or more days' disability, or whereby any property damage in excess of \$150 shall have been caused. Such first report shall later be supplemented by as full a statement as is possible of the cause and details of the accident and the precautions, if any, which have been

taken to prevent similar accidents. And, furthermore, each utility shall give all reasonable assistance to the Commission in the investigation of the cause and suitable means for prevention of any such accidents.

I. COMPLAINTS

Each utility shall make a full and prompt investigation of all complaints made to it by its consumers, either directly or through the Commission, and it shall keep a record of all complaints received, which shall show the name and address of the complainant, the date and character of the complaint and the adjustment or disposal made thereof. These records shall be open at all times to the inspection of an authorized representative of the Commission.

J. INFORMATION FOR CONSUMERS

Each utility shall give to its consumers such information and assistance as is reasonably possible, in order that consumers may secure safe and efficient service and may purchase lamps and appliances properly adapted to the service furnished. Each utility shall inform each consumer of any change made or proposed to be made in any condition of its service that would affect the safety of operation, or would require changes in or adjustment of the appliances or equipment which may be in use by said consumer. Each utility supplying metered service shall adopt means to inform its consumers as to the method of reading meters, in some form to be readily understood by the consumer.

It is recommended that an exhibition meter be kept on display in each commercial office maintained by a utility.

J-1. LAMPS FURNISHED BY UTILITIES

Lamps furnished by utilities to consumers without charge (free renewals) or at prices less than open market prices, should be of such efficiency in watts per candle when used on the utility's circuits of standard voltage as defined in Special Rule 2, that the cost of light per candle-power hour will not exceed the cost per candle-power hour, when similar lamps are bought in the open market.

K. METER READINGS AND BILL FORMS

1. The register of each service meter shall read in the same unit as that upon which the rate for service is based; and if not reading directly, the constant shall be plainly marked on the face of the dial.
2. Bills rendered to consumers for metered service shall show the readings of the meter for the beginning and ending of the period for which the bill is rendered, the number of units supplied, the dates of the meter readings and the price per unit.
3. Each utility having prepayment meters in service shall at the end of each collection period inform the consumer of the reading of the meter, as well as the amount of money taken from the meter for the period corresponding to the meter reading.

L. METER RENTALS AND DEPOSITS FROM CONSUMERS

1. No meter rental, as distinguished from a minimum charge for service, shall be charged by any utility for any service meter installed by it for measurements upon which bills are rendered; provided, however, that in cases where service meters are used as sub-meters to a main meter, a minimum charge for such sub-meter may be established, with the approval of the Commission.
2. No utility shall require from any consumer or prospective consumer a deposit intended to pay for all or any part of the cost of extension or installation of service, except under rules and regulations approved by the Commission and set down in the published schedules of the utility.

3. (a) A utility may require from any consumer or prospective consumer a cash deposit or other guaranty of an amount not to exceed twice the estimated periodic bill of such consumer. Interest thereon at the rate of 6 per cent per annum, payable upon the return of the deposit or annually upon demand by the consumer, shall be paid by the utility to each consumer making such deposit, for the time such deposit was held by the utility and the consumer was served.

(b) Each utility having on hand deposits from consumers, or hereafter receiving deposits from consumers, shall keep records to show: (1) The name of each consumer making a deposit; (2) the premises occupied by the consumer when making the deposit and each successive premises occupied while the deposit is retained by the utility; (3) the amount and date of making the deposit; and (4) a record of each transaction, such as payment of interest, interest credited, etc., concerning such deposit.

(c) Each utility shall issue a certificate of deposit to every consumer from whom a deposit is received.

(d) Each utility shall provide reasonable ways and means whereby a depositor, who makes application for the return of his deposit or any balance to which he is entitled, but is unable to produce the original certificate of deposit or receipt, may not be deprived of his deposit or balance.

1. CONTINUITY OF SUPPLY

Each utility shall maintain its equipment and transmission and distribution lines and appurtenances in an operating condition in conformity with good practice, and shall create and maintain such periodic inspection and maintenance as will reasonably insure continuous and good service within the hours of operation. A complete record shall be kept of all such inspection, which record shall clearly show the condition of all equipment and lines and appurtenances. The record shall be, at all times, subject to inspection by an authorized representative of the Commission.

2. VOLTAGE VARIATION

(a) Each utility supplying a constant potential service shall adopt standard supply voltage or voltages for its system, or larger divisions thereof, and every reasonable effort shall be made to maintain such voltage constant at all times during which service is supplied. The variation above or below standard voltage shall not exceed 6 per cent of such standard voltage at any time between sunset and 11 p. m. On power circuits and during other than lighting hours, the voltage shall not vary at any time more than 8 per cent from the standard (except in the case of power supplied from electric railway lines). In the case of special contracts for lighting or power service not connected with the principal distribution system of the utility, such service may be supplied under conditions of greater voltage variation when approved by the Commission.

(b) Purely momentary variations due to the operation of existing consumers' installations lasting not more than one minute in each instance, shall not be considered a violation of this rule, provided such momentary variations do not occur with such frequency as to render the service to other consumers unsatisfactory.

NOTE.—Each utility should adopt, and file with the Commission, rules governing the type and character of consumers' power installations and appliances thereafter permitted to be connected to the utility's system.

(c) Standard voltage is defined as that voltage which should be maintained on secondary bus lines or the distribution network, to which consumers' service lines are connected.

3. FREQUENCY VARIATION

Each utility supplying alternating current shall endeavor to maintain the standard frequency at a constant value; the variation from such standard frequency shall not

be greater than 5 per cent at all times during which service is supplied. Momentary variations of frequency of more than 5 per cent which are clearly not due to lack of proper equipment or reasonable care in operation, shall not be considered a violation of this rule. No condition shall be allowed to maintain which contributes to even momentary variations of as much as 10 per cent.

4. METER TESTING AND ACCURACY

NOTE.—It is recommended that all electric service and the rates therefor be based upon the registration of an established type of watthour or other approved meter, and that flat rates be resorted to only when the conditions clearly do not justify a metered service.

(a) All meters shall be tested before installation and adjusted to the accuracy prescribed. No meter shall be placed in service unless its accuracy has been established and has been approved and marked with the established seal of the Commission. No meter shall be placed, or allowed to remain in service without adjustment and correction: (1) that "creeps" under any commercial range of voltage; (2) that is in any way mechanically defective; or (3) that has an incorrect ratio or constant. No meter shall be placed in service that has an error in registration of more than 1 per cent; no meter shall be permitted to remain in service that has an error in registration of more than 2 per cent, when compared with approved working standards, as prescribed in General Rule E 2 (a). Adjustment of meters preparatory to placing in service shall not be consistently fast, but the allowable error must be construed as "leeway" in testing only.

(b) Before being placed in service, all meters shall be tested at "light" load and at "full" load. "Light" load shall be between 5 per cent and 10 per cent of rated capacity for induction type meters, and approximately 15 per cent of rated capacity for commutating type meters; "full" load is approximately 100 per cent of rated capacity. The adjustment to 1 per cent error prescribed in (a) shall be the result of at least two consecutive runs each at light and full load, which two runs must agree within one-half per cent. The condition of the meter shall be the average result of the tests at light and full load.

5. METER TESTING ON REQUEST OF CONSUMERS

(a) Each utility shall, at any time when requested by a consumer in writing, test the accuracy of the meter in use by him; provided, (1) that the meter in question has not been tested either by the utility or by the Commission within one year previous to such request; and (2) that the consumer will agree to accept the result of the test made by the utility as determining the basis for settling the difference claimed; provided, that a record of such test is submitted to the Commission by the utility in such detail that the result may be checked. No charge shall be made to the consumer for any such test. A written report giving the result of every such test shall be made to the consumer.

(b) Upon formal application by a consumer to the Commission a test will be made of the consumer's meter as soon as practicable by an inspector of the Commission. The application for such test shall be accompanied by a deposit of \$1. If the meter is found to be more than 4 per cent fast the deposit will be returned to the consumer by the Commission and the amount thereof shall be paid to the Commission by the utility. If the meter is found to be 4 per cent or less fast the deposit will be retained and disposed of according to law.

(c) The test shall be made at light, normal and full loads under conditions prescribed in Rule 4 (b) with the addition of the test at normal load below outlined and the meter accuracy shall be determined as follows: The average of these tests, obtained by multiplying the average result of the test at normal load by three, adding the average

result of the tests at light load and at full load, and dividing the total by five, shall be deemed the condition of the meter. A meter so tested shall be deemed an illegal meter if the error is more than 4 per cent to the prejudice of the consumer. The following classification, in percentage of connected load, shall be used in determining the normal load, unless the demand has been actually measured:

CLASSIFICATION OF INSTALLATION TO BE USED IN TESTING METERS AT NORMAL
LOAD

	Per cent
A. Residence and apartment lighting	25
B. Elevator service	40
C. Factories (individual drive), churches and offices	45
D. Factories (shaft drive), theaters, clubs, entrances, hallways and general store lighting	60
E. Saloons, restaurants, pumps, air compressors, ice machines and moving-picture theaters	70
F. Sign and window lighting and blowers	100

6. INSTALLATION AND PERIODIC TESTS

(a) Each utility furnishing metered service shall make periodic tests on consumers' premises as follows:

Induction type meters at least every 36 months.

Commutating and all other type meters at least every 18 months.

In placing new or readjusted meters on a consumer's premises, after having fulfilled the test conditions set out in paragraph 4 (b), the meter shall be given an installation test as follows:

Induction type meters, either before installation or within 30 days thereafter.

Commutating and all other type meters, within 60 days after installation.

Such installation test shall be coincident with and also constitute the first periodic test prescribed in the preceding paragraph; and this coincident test and subsequent periodic tests shall be made under the conditions prescribed in paragraph 4 (b); provided, however, that if the meter is found more than 2 per cent in error in registration the test shall then be repeated under the conditions prescribed in paragraph 5 (c).

(b) Whenever on installation, periodic or any other tests, a meter is found to exceed 2 per cent error in registration, it must be adjusted so as to register correctly to within 1 per cent, when compared with approved working standards as prescribed in General Rule E 2 (a).

(c) All tests on watthour meters in service shall be made in the place of permanent location on the consumers' premises with approved testing apparatus and under local conditions of operation, unless otherwise stated in any rule or allowed by special order of the Commission.

APPENDIX 4

Be it ordained by the City Council of the City of Chicago (July 15, 1915):

SECTION 1. *The Duty of Commissioner of Public Service.*—It shall be the duty of the Commissioner of Public Service to provide for the test, inspection, sealing and adjustment, in accordance with the provisions of this ordinance, of all meters as hereinafter defined, used or to be used in the city of Chicago.

SEC. 2. *Authority of Commissioner of Public Service.*—Working standard tests, complaint tests and proof tests, as hereinafter defined, shall be made by the Commissioner of Public Service, or his representative, in the manner hereinafter provided.

SEC. 3. *Definition of Seller, Meter and Consumer.*—Paragraph 1. The term "seller" when used in this ordinance shall mean and include any corporation, company, association, joint stock company or association, firm, partnership, managing committee

or individual, their lessees, trustees, or receivers appointed by any court whatsoever (except, however, such public utilities as may now or hereafter be owned or operated by any municipality), that now or hereafter may own, control, operate or manage within the city of Chicago, directly or indirectly, any plant, equipment or property used in connection with the production, storage, transmission, sale, delivery or furnishing of electrical energy within the city of Chicago, may offer such utility for sale to the public, and may use the public streets or alleys of said city for the purpose of conveying its said utility to its customers.

Paragraph 2. The term "meter" when used in this ordinance shall mean and include each and every electrical device that is used in the city of Chicago for the purpose of measuring the electricity supplied any consumer thereof.

SEC. 4. *Definition of tests.*—Paragraph 1. Whenever any meter shall be installed for the purpose of measuring electricity to be used by any consumer, it shall be tested and adjusted, as hereinafter provided, within 90 days from the time of its installation. The test so to be made within 90 days is referred to in this ordinance as the "Installation test."

Paragraph 2. Whenever any person shall make application to the Commissioner of Public Service for a test of any consumer's meter, and shall present the receipt hereinafter prescribed, such test as hereinafter prescribed shall be made by the Commissioner of Public Service or his representative, and is referred to in this ordinance as the "Complaint test."

Paragraph 3. The Commissioner of Public Service shall make tests of meters upon the premises of consumers, for the purpose of checking up and testing the accuracy of the tests made by the meter testers of the seller of such a number of consumers' meters as the Commissioner of Public Service shall deem sufficient for that purpose. The test so to be made is referred to in this ordinance as the "Proof test."

SEC. 5. *Testing Meters of Sellers.*—Paragraph 1. Meters installed by sellers in the premises of consumers shall be tested by competent meter testers, employed by the seller, in the manner provided in this ordinance, but by means only of working standards or standard test meters, which shall be inspected, tested and sealed by the Commissioner of Public Service of the city of Chicago, or his duly authorized representative, once in every 10 days. When such inspection and test shall have been made, the Commissioner of Public Service, or his duly authorized representative, shall place upon the working standard or standard test meter so inspected and tested, a seal which shall indicate that such meter has been inspected and tested by the city of Chicago, and such seal shall set out the date of such test.

It shall not be lawful for any such seller, or any officer or agent of such seller, to use, or permit the use of, any such working standard or standard test meter in and about the inspection or testing of any meter used in measuring the electricity sold by such seller to any consumer, unless such working standard or standard test meter shall have been tested, inspected and sealed under the provisions of this ordinance, within a period of 10 days preceding the date of its use for such purpose by or for such seller, and unless the seal placed thereon as herein provided shall at the time be unbroken.

Paragraph 2. It shall be the duty of any person making the test provided for in this section to permit the consumer whose meter is about to be tested, or his representative, to examine the seal affixed by the Commissioner of Public Service thereon.

Paragraph 3. The tests required to be made by the Commissioner of Public Service as provided for in this section shall be made at the expense of the seller, and the fee to be charged for each test and sealing of each such working standard or standard test meter shall be not more than 40 cents for each such working standard or standard test meter so tested.

Paragraph 4. It shall be the duty of every seller to file with the Department of Public Service, on or before tenth day of each calendar month, a report of all the meters tested in behalf of such seller on consumer's premises, showing the results of

such tests in accordance with rules and in the manner to be prescribed by the Department of Public Service, and in addition thereto such seller shall keep on file for inspection by the Department of Public Service a complete record of every test made by it on consumer's meters for a period of two years after the date of such tests.

SEC. 6. *Removing Seal—Penalty.*—Paragraph 1. It shall be the duty of the Commissioner of Public Service to cause all working standards or standard test meters of sellers to be properly sealed in accordance with the provisions of this ordinance, and no such working standard or standard test meter shall be used by any seller, or any officer, agent, or employee of such seller, unless the seal placed thereon by the Commissioner of Public Service shall be intact.

Paragraph 2. It shall be the duty of the Commissioner of Public Service to report forthwith to the prosecuting attorney of the city the names and addresses of all sellers and persons violating any of the provisions of this ordinance; and of sellers and persons making use of any fraudulent meters, and of all sellers or consumers, or of their agents or employees, using any working standards or standard test meters unsealed in violation of the provisions of this ordinance.

SEC. 7. *Proof Tests.*—Paragraph 1. It shall be the duty of the Commissioner of Public Service to make or cause to be made proof tests of meters in his discretion at such time and in such manner as he shall regard most likely to effectually check the testing done by or on behalf of such seller, and to detect any fraudulent or unlawful practices of such seller or its agents or employees; provided, that such tests shall only be made after the Commissioner of Public Service shall have given to the seller 48 hours previous notice in writing, by mail or by personal service, that he is about to make such tests and desires the attendance of a representative of the seller at his office in the city hall for that purpose at a given time, and in the presence of such representative of such seller, if he shall attend for that purpose, pursuant to the notice; provided, further, however, that such notice shall not designate the location or contain a description of the meters the commissioner intends to test.

SEC. 8. *Complaint Tests.*—It shall be the duty of the Commissioner of Public Service, upon request of any consumer, to examine and test any meter furnished to such consumer by the seller, and used for the purpose of measuring electricity supplied to such consumer by such seller. Such inspection shall be made substantially in accordance with the following requirements:

(a) Any consumer desiring the inspection of any electric meter within the city, as provided for in this ordinance, shall accompany the application for such inspection with a fee as hereinafter prescribed, which shall be paid to the city collector showing such payment, which receipt shall describe the location of the electric meter to be inspected and its rated capacity, and shall contain the name of the person, firm, or corporation for whose benefit said electric meter was installed. Said receipt when presented to said Commissioner of Public Service shall be his authority for making the inspection herein provided for.

(b) Before making such inspection or test the Commissioner of Public Service shall give notice in writing to the consumer making application therefor, and also to the seller whose meter is about to be inspected, setting forth in such notice the time when and place where such inspection or test of such meter is to be made. Such notices shall be mailed at least 48 hours before the time set for the inspection of such meter. The notice sent to the consumer shall be addressed to the premises described in the application for inspection and wherein the meter to be inspected is installed. The notice to the seller whose meter is to be inspected shall be addressed to the principal office of such seller in the city of Chicago. The inspection of any such meter shall be made by the Commissioner of Public Service, or his duly authorized agent, at the place where the meter is installed and in place, and such inspection shall be made in such a manner as to thoroughly test such meter, for the purpose of ascertaining whether

it registers correctly under the applicant's usual conditions of use of electricity furnished by the seller whose meter is to be inspected.

SEC. 9. *Standard Meters.*—There shall be maintained and kept at all times, in the office of the Commissioner of Public Service, primary standard instruments for the measurement of electro-motive force and current for both alternating current and direct current, which instruments shall be accurate to within one-tenth of 1 per cent when compared with the standards of the United States Bureau of Standards and it shall be the duty of said Commissioner of Public Service to have all such instruments tested, sealed and certified by the United States Bureau of Standards, at least once every six months. The primary instruments so maintained and kept shall be used as standards for the purpose of checking the working standards used by said Commissioner of Public Service.

SEC. 10. *How Tests Shall be Made.*—Paragraph 1. Any electric meter inspected or tested by said Commissioner of Public Service, or by a seller, under and in accordance with the provisions of this ordinance, shall be deemed accurate if it registers not to exceed 4 per cent above or below the reading of the working standard. Every meter tested or inspected under or in accordance with the provisions of this ordinance shall be tested for the purpose of ascertaining its accuracy on "light load," and "full load" of said meter.

Paragraph 2. The term "light load" shall mean a load equivalent to 10 per cent of the rated capacity of the meter. The term "full load" shall mean a load equivalent to any load between 80 per cent and 100 per cent of the rated capacity of the meter.

Paragraph 3. Whenever a meter inspected or tested under and in accordance with the provisions of this ordinance by the Commissioner of Public Service shall be found to be inaccurate, as in this ordinance defined, such meter shall be accurately adjusted by the seller, so as to make it accurate within the limits herein defined, and if, in the opinion of the Commissioner of Public Service, said meter can not be made accurate within the limits as so defined, then the Commissioner of Public Service shall have the power to order the installation of another meter in lieu of the one found to be inaccurate, and it shall thereupon be the duty of the seller to install another meter in compliance with such meter.

Paragraph 4. Whenever a meter inspected or tested under and pursuant to the provisions of this ordinance, by or on behalf of a seller, shall be found inaccurate, as defined in this ordinance, the seller shall either immediately accurately adjust such a meter or replace the same by another meter within 10 days.

Paragraph 5. *Creeping Meter:* No meter which registers on no load where the applied voltage is less than 110 per cent of standard service voltage shall be placed in service or allowed to remain in service.

SEC. 11. *Incorrect Meter—Rebates—Deficiency Charge.*—Paragraph 1. Whenever any meter shall be inspected or tested under the provisions of section 8 of this ordinance, a test reading of such meter shall be made at its usual average load, if such load can be determined, and, if such load can not be determined, then it shall be tested at its "normal load" as hereinafter fixed. If any such meter shall register to exceed 4 per cent above or below the working standard at the usual or "normal load" it shall be deemed incorrect for the purpose of this section.

Paragraph 2. The following classification, in percentage of rated capacity, shall be used in determining the "normal load," above specified, of various meters:

- (a) Residence and apartment lighting, 25 per cent.
- (b) Elevator service, 40 per cent.
- (c) Factories (individual drive), churches and offices, 45 per cent.
- (d) Factories (snaff drive), theaters, clubs, entrances, hallways and general store lighting, 60 per cent.

(e) Saloons, restaurants, pumps, air compressors, ice machines and moving picture theaters, 70 per cent.

(f) Sign and window lighting and blowers, 100 per cent.

Paragraph 3. When a meter is found to be connected to an installation consisting of two or more of the above classes of loads, the "normal load" must be obtained by taking the average of the percentage for the classes so connected. If the result of such test at such usual or "normal load" shall show any meter to be incorrect, as above defined, it shall be presumed that such meter was in the same condition and incorrect to the same degree for a period of not to exceed 90 days prior to the date of such inspection or test.

Paragraph 4. Nothing herein contained, however, shall be held to preclude either the consumer or the seller from establishing by competent evidence the fact that such meter was or was not incorrect for a longer or shorter period of time than 90 days prior to the date of such last inspection.

Paragraph 5. Where the result of any inspection by the Commissioner of Public Service, made under and in accordance with this ordinance, shows that the meter so inspected is incorrect, as herein defined, and such incorrectness shall operate to the disadvantage of the consumer by causing to be registered a greater amount of electricity than actually flowed or passed through such meter, in such case such consumer shall be entitled to a rebate from the seller, based upon the assumption that such incorrect registration existed for a period of 90 days prior to the date of said inspection or test; provided, however, that if the consumer shall be able to establish the fact that such condition existed for a longer period than said 90 days, or if the seller shall be able to establish the fact that such condition did not exist for so long a period as said 90 days, then, and in either event, the consumer shall be entitled to a rebate for such period of time as it shall be shown such meter registered a greater amount of electricity than actually passed through the same.

Paragraph 6. If the result of any inspection, made by the Commissioner of Public Service under and in accordance with this ordinance, of any meter shall show that such meter is incorrect, and that such incorrectness operated to the disadvantage of the seller by reason of such meter registering a smaller amount of electricity than actually passed through same, in such case such condition shall be presumed to have existed for a period of not to exceed 90 days prior to the date of such inspection, and such seller shall be entitled to charge the consumer an amount equal to what would have been charged had the meter registered correctly, said amount to be based upon the assumption that said meter registered incorrectly in the same degree for a period of not to exceed 90 days prior to the date of such inspection; provided, however, that if the seller shall be able to establish the fact that such condition existed for a longer period than said 90 days, or if the consumer shall be able to establish the fact that such condition did not exist for so long a period as said 90 days, then, and in either event, the seller shall be entitled to charge said consumer for such deficiency during the time that said deficiency shall be shown to have existed.

SEC. 12. *By Whom Inspection Fee Paid.*—If the result of any complaint test, made under and in accordance with the provisions of this ordinance, shall show any meter so inspected to be inaccurate or incorrect, as defined herein, on any test hereinbefore provided, and to be registering a greater amount of electricity than passes through the same, within the limits fixed therein, the amount advanced by the consumer requesting such inspection shall be forthwith returned to him, and such inspection or test shall be made without cost or expense of any kind whatsoever to such consumer; and in such case the fee provided for such inspection or test shall be charged to and paid by the seller installing or using the meter so found to be inaccurate or incorrect. If the result of such inspection or test shall show such meter not to be registering

a greater amount of electricity than passes through the same, within the limits fixed herein, the expense and cost of such inspection or test shall be paid out of the fee required to be advanced by the consumer making the application for such inspection, and no part of the fee so advanced shall in such case be returned to such applicant. The current consumed or used in making such inspection or test shall not be charged to the account of such consumer.

SEC. 13. *Binding Character of Tests.*—The inspection and test herein provided for, to be made by the Commissioner of Public Service, shall be conclusive upon both the consumer making application for such inspection or test and the seller installing or using such meter.

SEC. 14. *Schedule of Fees for Complaint Test.*—The following shall be the fees charged by the Commissioner of Public Service, upon a complaint test, for the inspection or testing of electric meters operating on circuits of 500 volts or less, to wit:

AMPERES, RATED CAPACITY	Fees
Ten, or less.....	\$0. 50
Over 10, but not more than 25.....	1. 00
Over 25, but not more than 50.....	3. 00
And for each additional 25 amperes, or fraction thereof.....	. 50
For each 1000 volts, or fraction thereof, over and above 500 volts.....	1. 00

SEC. 15. *Records to be Kept.*—Said Commissioner of Public Service shall keep a register or registers in his office in the city hall in which he shall record the number and description of each meter inspected by him and the time of such inspection and the condition of meter when inspected and all reports filed with him, together with all notices sent or given by him and all other proceedings of his office in reference thereto. Such records shall at all times be open to the inspection of the mayor, any member of the city council, the head of any department, or any citizen of the city of Chicago. Such records shall be kept for a period of two years after the date of such tests.

SEC. 16. *Copies of Reports.*—Any consumer shall at any time be entitled to receive from the Commissioner of Public Service a copy of any report or record, whether made by the Commissioner of Public Service or his representative, or by or on behalf of any seller, and on file in the office of the Commissioner of Public Service, in so far only as relates to the meter of such consumer, upon the payment of a fee of 25 cents to the Commissioner of Public Service.

SEC. 17. *Monthly Report.*—Said Commissioner of Public Service shall immediately after the first of each month prepare and submit to the comptroller a report of the number of electric meters inspected during the previous month, and of any fees collected by him under the provisions of this ordinance.

SEC. 18. *Penalties.*—Any seller or consumer or any officer, agent, or employee of either such seller or consumer, who shall violate or refuse to comply with any of the provisions of this ordinance, shall be fined (except as herein otherwise provided) not more than \$200 for each offense. A separate and distinct offense shall be held to have been committed each day any seller or consumer violates or fails to comply with the provisions of this ordinance.

SEC. 19. *Repealing Clause.*—Sections 838, 839, 840, 841, 842, 843, 844, and 845 of the Chicago Code of 1911 are hereby repealed.

SEC. 20. This ordinance shall take effect and be in force from and after its passage and publication.

APPENDIX 5**CALIFORNIA RAILROAD COMMISSION. (CASE NO. 683)**

In the matter of the practice of water, gas, electric, and telephone utilities requiring deposits before rendering service. Nov. 5, 1915.

PART I

The following rules and regulations are hereby found to be just and reasonable rules and regulations, and are hereby established as rules and regulations to be obeyed and followed by all water, gas, electric, and telephone utilities doing business within California.

I. SERVICE CHARGES**A. METERED SERVICE**

RULE 1. A water, gas, electric, or telephone utility may, under uniform nondiscriminatory rules and regulations, require that an applicant for metered or measured service establish his credit before service is delivered, unless a prepayment device makes such procedure unnecessary. The applicant's credit will be deemed established if he (1) owns the premises; or (2) makes a cash deposit; or (3) furnishes a guarantor for the payment of his bills, satisfactory to the utility; or (4) has paid all his bills to the utility promptly during the 12 months prior to the effective date of the order herein.

RULE 2. If an applicant for metered or measured service makes a cash deposit to insure payment for service to be delivered, the amount of the deposit shall be such as may be specified in the utility's rules, but in no event in excess of twice the average periodic bill of consumers of his class; provided, that the deposit for domestic or residence monthly service of water, gas, electric, and telephone utilities shall not exceed \$2.50, except that where the average of the monthly bills of those consumers of any class of domestic or residence service who make deposits is in excess of \$2 such consumers may be called upon to make deposits of uniform amount not exceeding twice such average.

RULE 3. If a consumer who has initially established his credit by showing that he is the owner of the premises, or by supplying a guarantor satisfactory to the utility, or by paying all his bills to the utility promptly during the 12 months prior to the effective date of the order herein, later fails to pay his bills, the utility may demand as guaranty for the payment of future bills a cash deposit in the amount provided in rule 2; provided, that service may not be discontinued for failure to make such deposit until the time specified in rule 5 hereinafter, notice of intention to discontinue service unless such demand is complied with.

RULE 4. If a consumer who has made a cash deposit fails to pay a bill for metered service, the utility may apply the deposit in so far as necessary to liquidate the bill and may require that the deposit be restored to its original amount; provided, that service may not be discontinued until the deposit has been fully absorbed, and in no event until the expiration of the respective periods of time after notice of intention so to do, as specified in rule 5, herein.

RULE 5. A water, gas, electric, or telephone utility may not, for failure to make a deposit, discontinue a metered service for which bills are normally made out monthly until the expiration of at least 15 calendar days after written notice of intention so to do; nor where the bills are normally made out weekly until the expiration of at least 4 calendar days after written notice of intention so to do; nor where the bills are normally made out fortnightly until the expiration of at least 7 calendar days after written

notice of intention so to do; nor where the bills are normally made out for periods in excess of one month, until the expiration of at least 30 calendar days after written notice of intention so to do.

RULE 6. A water, gas, electric, or telephone utility may not discontinue service by reason of nonpayment of bills for metered or measured service theretofore delivered, in cases in which there is a dispute as to the amount of the bill. In case of such dispute, the consumer shall deposit with the Railroad Commission the amount claimed by the utility to be due, whereupon the Railroad Commission will investigate the facts and communicate its findings to the parties. Failure on the part of the consumer to make such deposit within 15 days after demand by the utility that such deposit be made, shall warrant the utility in discontinuing the service.

RULE 7. A telephone utility may, under uniform, nondiscriminatory rules and regulations, extend the convenience of sending telegrams and long distance telephone messages on credit to all of its subscribers. If a subscriber's credit is impaired by his failure to pay for such service rendered, the utility may, after the reasonable notice specified in rule 5 herein, unless there is dispute as to the amount of the bill, deny to him further telegraph or long distance telephone service until he pays the amount due and makes a deposit, not in excess of twice his average periodic bill for such service, to cover charges for future telegrams and long distance telephone messages.

B. UNMETERED SERVICE

RULE 8. A water, gas, electric, or telephone utility delivering unmetered service at flat rates, may under uniform, nondiscriminatory rules and regulations, require payment in advance of delivery, for a period not to exceed that for which bills are regularly rendered as specified in the rate schedule, but may not demand guaranties to secure payment for service, to be rendered in the future.

RULE 9. A water, gas, electric, or telephone utility may not for failure to pay for service, discontinue an unmetered service for which bills are normally made out monthly until the expiration of at least 15 calendar days after written notice of intention so to do; nor where the bills are normally made out weekly until the expiration of at least 4 calendar days after written notice of intention so to do; nor where the bills are normally made out fortnightly until the expiration of at least 7 calendar days after written notice of intention so to do; nor where the bills are normally made out for periods in excess of one month, until the expiration of at least 30 calendar days after written notice of intention so to do.

C. RETURN OF DEPOSITS

RULE 10. After a cash deposit to guarantee payment for metered or measured service has stood unimpaired for 12 months, it shall be returned to the depositor. Upon closing any account the balance of any deposit remaining after the closing bill for service has been settled shall be returned promptly to the depositor.

RULE 11. Interest at the rate of 6 per cent per annum must be paid by each water, gas, electric, or telephone utility on all deposits held by it to secure the payment of bills for metered service; provided, that interest need not be paid if the service is discontinued within less than 12 months from the date of first taking service.

D. CONTRACTS

RULE 12. Except in the case of extensions in unincorporated territory, which matter is left open for consideration in subsequent proceedings, and of extensions in incorporated territory in cases in which the Commission may hereafter authorize the signing of contracts for service, a water, gas, electric, or telephone utility may not require that an applicant sign a contract for service as a condition precedent to service; provided, that such utility may require that reasonable written application for service be made.

II. SERVICE CONNECTIONS

RULE 13. A water, gas, electric, or telephone utility which operates upon, under or along any public street, highway, alley, lane or road shall at its own expense install a service connection of normal size to the property line or curb line of property abutting upon said public street, highway, alley, lane or road or to such point on the consumer's premises as the utility may agree upon. The term "service connection," as herein used, shall include water and gas pipes, electric and telephone wires, water, gas, and electric meters, electric transformers, gas regulators, telephone instruments, and appurtenances. Subject to review by the Railroad Commission, a water, gas, electric, or telephone utility may refuse to make a service connection if it believes that the service will not be used in the reasonably immediate future.

RULE 14. Under reasonable, nondiscriminatory rules and regulations, to be prepared in the first instance by the utility, subject to review by the Railroad Commission, a water, gas, electric, or telephone utility may provide that the cost of disconnecting and reconnecting service connections may be (1) charged directly to the new or the resuming consumer; or (2) distributed over the periodic payments over a reasonable period of time; or (3) merged in the general operating expenses. The so-called "cancellation charges" of water, gas, electric, and telephone utilities are hereby abolished.

III. EXTENSIONS

RULE 15. A water, gas, electric, or telephone utility which operates under a general franchise authorizing the occupancy of all the streets of a municipality shall make, at its own expense, such street extensions as may be necessary to serve applicants; provided, that in any case in which the construction of an extension at the utility's sole cost will in its opinion work an undue hardship upon the utility or its existing consumers, the matter may be submitted to the Commission as provided by section 36 of the Public Utilities Act, unless satisfactorily adjusted by an informal application to the Commission.

RULE 16. A water, gas, electric, or telephone utility shall make such reasonable extensions in unincorporated territory at its own expense as it can agree upon with the applicant for service; provided, that in any case in which the construction of an extension at the utility's sole expense will in its opinion work an undue hardship upon the utility or its existing consumers, the matter may be submitted to the Commission as provided by section 36 of the Public Utilities Act, unless satisfactorily adjusted by an informal application to the Commission.

RULE 17. In cases in which applicants make payments to secure the construction of extensions by water, gas, electric, or telephone utilities, such payments shall generally be considered as loans to the utilities, to be repaid, as soon as conditions warrant, under reasonable nondiscriminatory rules and regulations.

IV. MODIFICATIONS OF RULES

RULE 18. A water, gas, electric, or telephone utility may establish uniform non-discriminatory rules more favorable to its consumers than the rules herein established.

PART II

The rules and regulations herein established shall take precedence over orders heretofore made by the Commission in other proceedings, in so far as said orders may be inconsistent with said rules and regulations.

PART III

The rules and regulations herein established shall take precedence over all rules and regulations filed or to be filed by water, gas, electric, and telephone utilities in so far as inconsistent therewith. Rules and regulations now on file and inconsistent with the rules and regulations herein established should be revised and refiled within 30 days from the effective date of this supplemental order.

PART IV

(a) Within 30 days after the effective date of this supplemental order, each water, gas, electric, and telephone utility shall return to the depositor all deposits heretofore made to guarantee payment for flat rate service, and deposits made to guarantee payment for metered or measured service by customers who have paid all their bills promptly during the 12 months prior to the effective date of this supplemental order, and (b) within 30 days after demand, each water, gas, electric, and telephone utility shall return all deposits made to guarantee payment for metered or measured service to customers who have paid all their bills promptly during the period of service, in cases in which the service has lasted less than 12 months; provided, that such customers shall show ownership of the premises or shall offer guarantors satisfactory to the utility; except that if the utility so desires it may apply the existing deposit against current bills until the deposit is absorbed.

PART V

If hardship results from the application to special facts of any rule or regulation herein prescribed, application may be made to the Railroad Commission for a modification.

PART VI

This order shall become effective on December 1, 1915.

Dated at San Francisco, California, this 5th day of November, 1915.

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